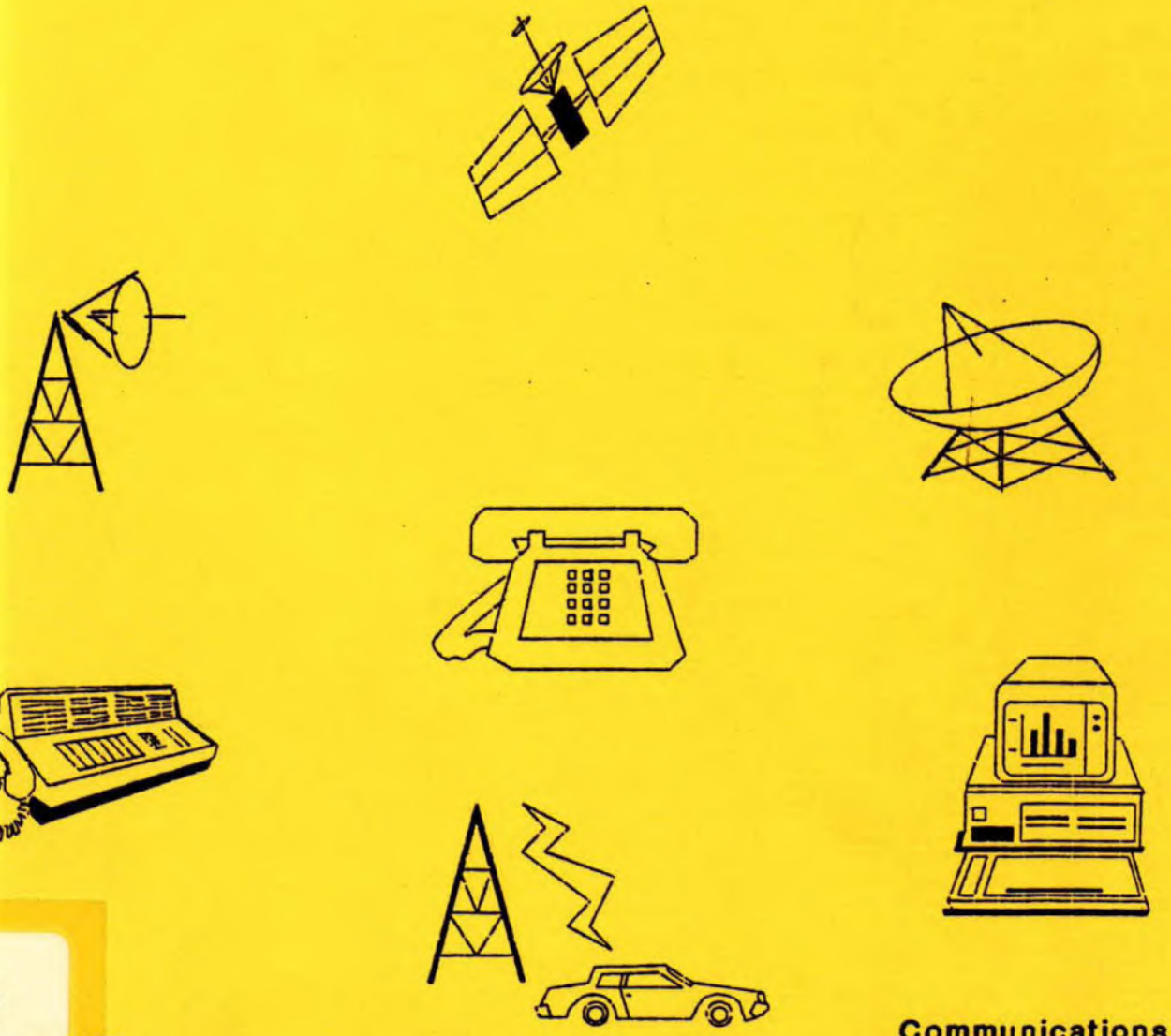
Public, Private and Shared Telecommunications Networks

A Cross-Impact Study to the Year 2000



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Communications Canada

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Final Report

to the

Department of Communications

March 1989

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1.0 INTRODUCTION

This chapter outlines the purpose of the study including a description of the work which was required, discusses the cross-impact methodology which was adopted and presents the results of our investigations of alternative cross-impact methodologies including why they were rejected and the circumstances under which they might be applicable.

1.1 Purpose of the Study

The Terms of Reference for this study are as follows:

1. To investigate and analyze the technological, economic and regulatory factors affecting the demand by business for public, private and shared network facilities and services to the year 2000.

2. To identify and extrapolate the technological, economic, regulatory and other trends influencing the supply of public, private and shared networks up to the year 2000.

3. To undertake a cross-impact analysis of the use of public, private and shared telecommunications networks by businesses up to the year 2000, under various pricing, technological, regulatory and other scenarios.

4. To analyze and identify those regulatory and other policies which affect this trade-off in the use of public, private and shared networks and derive qualitative and quantitative estimates of the impacts in the year 2000.

Further detail on study requirements can be found in Appendix A, which contains a copy of the Statement of Work for the study.

This study was commissioned by the federal Department of Communications (DOC) to develop a methodology and framework for assessing the cross-impacts of public, private and shared telecommunications networks over the next decade together with a qualitative assessment of the interaction of the various forces and factors that affect supply and demand over this time period. In this respect, the report identifies, analyzes and ranks those factors that are expected to have the greatest impact on the development of public, private and shared networks to the year 2000.

The telecommunications industry throughout the world is in a state of change driven by technological, economic and political factors. New technologies (for example, fibre optics and digital switching and transmission), integration of technologies and markets, deregulation and many other discrete changes all combine to create new supply and demand options. Historically, because of pricing and other factors, business customers have acquired private and, to some extent, shared networks to meet their communications requirements. The above factors have, in fact, increased the demand by business for private and shared networks rather than using the public network. For example, one of the results of deregulation and competition in the U.S. has been a proliferation of private networks driven in large part by the availability of alternative carrier systems, often based on fibre

optics.

The consequence for public policy is that this migration to private and shared networks could potentially jeopardize the ability of regulated common carriers to provide public communications services, particularly the provision of public telephone service at affordable prices. While there are a number of external factors which influence the supply of and demand for private and shared networks versus public networks, there are also various policy and regulatory factors which can influence the trade-off between public, private and shared networks. To assist in its policy-making role, DOC requires a knowledge of the importance and impacts of these factors in influencing future demand and supply of public, private and shared services. With this understanding it would be possible to develop policies and regulatory approaches to such critical areas as pricing, costing and competition which would ensure the provision of public services while permitting business the flexibility to acquire and use communications services to meet the full range of their requirements.

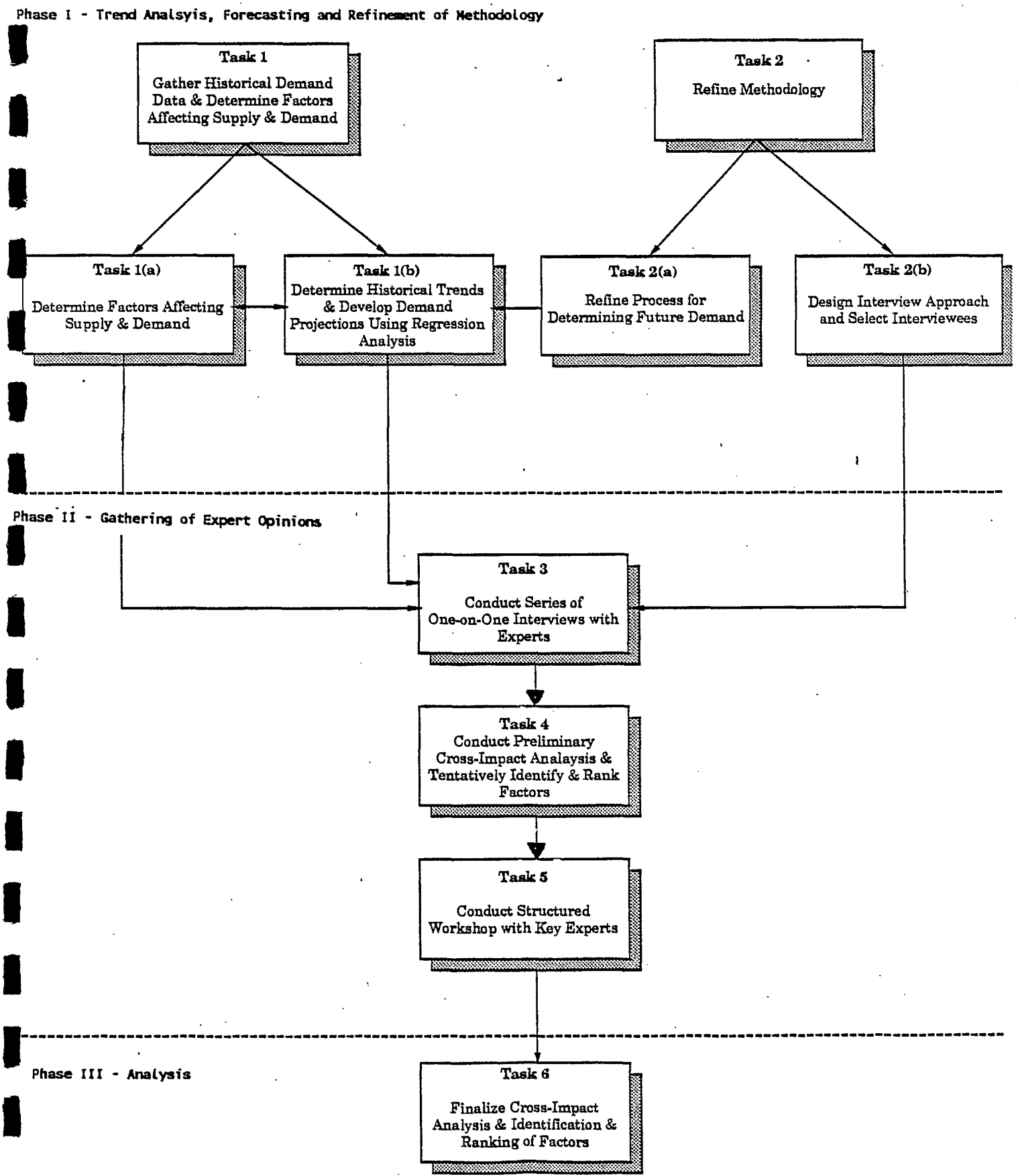
To this end, this report presents a methodology and framework for assessing the cross-impacts of public, private and shared networks and a ranking of factors expected to have the greatest impact on the evolution of public, private and shared networks in Canada to the year 2000.

It should be noted that the cross-impact analysis, instead of merely considering factors in isolation from one another, also inquires into the effects that the occurrence of any one of the factors would have on the probability of occurrence of the remaining factors.

1.2 Cross-Impact Methodology

Given that one of the objectives of the study is to develop a methodological framework for cross-impact analysis, the project itself was treated as a test of the proposed methodology. Exhibit 1-1 presents an overview of the selected methodology. This particular approach to cross-impact analysis was chosen after review of the literature and discussions with Dr. Roy Amara, President of the Institute for the Future, Menlo Park, California. Cross-impact analysis is a frequently used tool in futures research. Dr. Amara indicated that the elicitation of expert judgement is the key tool in the planning for future developments; in this context, determination of the factors affecting public, private and shared networks to the year 2000. The preferred vehicle is the structured workshop at which expert judgements may be elicited and aggregated. The workshop is normally preceded by one-on-one interviews with experts to set the stage for discussions. Appendix B provides an article entitled "Futures Methods" by Dr. Amara which was used as a basis for selecting and developing the methodology used in this study.

Exhibit 1-1: Overview of Cross-Impact Methodology



The methodology, as indicated in Exhibit 1-1 has three phases: Trend Analysis, Forecasting and Refinement of Methodology; Gathering of Expert Opinions; and Analysis. Phase I involved research on historical demand data (the use of public, private and shared networks), preliminary determination of factors affecting supply and demand and refinement of the methodology. Phase I also involved a regression analysis of historical demand data (network use) to predict future demand and associated revenues based on continuation of existing trends. The intent in conducting this regression analysis was to predict future use as a base against which discontinuities in trends or new events (e.g., technological change, policy change, etc.) could be measured. Whereas in theory this was a sound approach, in practice the availability of data on network use and trends was limited, necessitating abandonment of this aspect of the study. In this respect, explanatory data relative to public network usage were reasonably available but practically non-existent at the level of detail necessary to model demand for private and shared networks (available data are presented in Chapter 2.0). Hence, the lack of data limited the quantification of cross-impacts.

Phase II of the methodology involved the gathering of expert opinions through a series of one-on-one interviews and a structured workshop, as recommended by Dr. Amara. Interviews were conducted with experts in Canada and the U.S., representing

a cross-section of users, carriers, manufacturers, regulators, policy-makers and user and supplier organizations. The workshop was attended by a similar cross-section of experts, some of whom had been interviewed earlier, others who had not. Lists of those who were interviewed and who attended the workshop are presented in Appendix C.

Phase III involved an analysis by the project team of the results of the interviews and workshop. In addition to comments received at the workshop, some attendees subsequently provided written comments which were also included in the analysis.

During and following the workshop, comments were provided by a number of attendees regarding the workability of the methodology. These comments, together with an assessment by the project team, are presented in Chapter 5.0. In that chapter, it is indicated that additional steps are required, as determined from the experience gained in this study, to complete the methodology.

1.3 Other Cross-Impact Methodologies

During the course of the research on cross-impact methodologies, two other approaches emerged, as follows:

1) A mathematical approach based on creating and manipulating a numerical cross-impact matrix, usually with the aid of a computer program.

2) A quantitative approach based on expanding U.S. quantitative models of bypass to full cross-impact models.

In the present project these approaches would have required far more financial resources and time than allocated and hence were not adopted. A brief description of each is presented as options for further work in this area should that be desirable. The advantage of both methodologies is that they produce quantitative measures of cross-impacts. However, as we shall note, they also have their limitations.

Futures researchers use the mathematical approach to cross-impact analysis in areas where the subject matter can be tightly focussed and where trends and events that effect the subject matter can be determined and quantified. In the course of our research on cross-impact methodologies, the Institute for the Future provided a description of the model they use for such analysis.[1] This model, called DYCIM - Dynamic Cross-Impact Modelling, is described as providing a systematic approach to forecasting trends whose behaviour is not well quantified or when subjective as well as objective factors play an important role.

Within DYCIM, the effect of one variable on another is derived from judgemental rather than historical data. In contrast to econometric modelling, DYCIM is most useful when there is little historical data on which to base forecasts. DYCIM relies on the use of logistic functions, S-shaped growth curves that are common

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[1] The Use of DYCIM in Forecasting, Institute for the Future, Menlo Park, CA, February 4, 1983.

in many economic, physical and technological processes, to predict future behaviour.

The Institute for the Future has found that a variety of techniques can be used to collect the data for a DYCIM model. The most useful is the workshop, which may be preceded by interviews with experts. There are seven steps in the process:

1) Identification of Variables

   - development of exogenous and endogenous (input and output) variables.

2) Preparation of Preliminary Forecasts

   - development of preliminary forecasts for each of the variables.

3) Preparation of Elicitation Forms

   - preparation of forms for eliciting responses from participants. These forms include a preliminary forecast of the impacting and impacted variables, a step in the impacting variables and a scale for recording the respondent's expertise.

4) Instruction of the Participants

   - introduction to DYCIM;

   - explanation of preliminary forecasts, including explanation of all definitions;

   - explanation of the structure of the problem and identification of the most important interrelations.

5) Encoding the Results

   - recording of all cross-impacts from participants.

6) Processing of Results

- creation of a weighted average of each cross-impact graph;
- computation of the cross-impact matrix elements in accordance with the DYCIM formulation;
- starting with the initial value of each variable and the appropriate cross-impact matrix coefficients, new values for successive time periods are calculated.

7) Sensitivity Analysis

- exploration of the effects of varying the forecasts for the exogenous variables.

This process is very time consuming and complex as can be judged from this description. As indicated above, the process works best when the subject matter is well defined. We were advised by the Institute for the Future that application of DYCIM to the general determination of cross-impacts between public, private and shared networks would be far too complex to deal with in the process outlined. However, if the problem could be more tightly defined, DYCIM could be useful. For example, it might be possible to use this approach to study the impacts of various factors on the provision of MTS/WATS, rather than the full range of public, private and shared networks.

The second approach would involve expanding U.S. quantitative models of bypass into a cross-impact model based on the Canadian environment. Two organizations in the U.S., the Federal Communications Commission (FCC) and Bell Communications Research

(BCR), in 1984, released the results of separate simulation models that estimate how a fully competitive interstate access market with current 1984 access prices would have affected 1984 local telephone revenues. These models simulate the bypass of local telephone facilities by users in accessing interstate long distance carriers. The policy concerns are similar to those being investigated in the present study in that facilities not requiring access charge payments could be used to access long distance carriers, causing a negative impact on the local telephone company. Two types of bypass are defined: one, service bypass which involves the use of private lines leased from the local telephone company, which are generally dedicated to a customer's use and do not share the local exchange's general switching facilities; and, two, facilities bypass which involves the use of private telecommunications systems that avoid all local telephone company facilities. Details of the FCC model are described in a paper published in 1984 by the FCC.[2] The BCR model is secondarily described in a report on bypass to the Congress by the U.S. General Accounting Office.[3]

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[2] Bypass of the Local Exchange: A Quantitative Assessment, Gerald W. Brock, OPP Working Paper 12, Federal Communications Commission, Washington, D.C., September 1984.

[3] Telephone Communications: Bypass of the Local Telephone Companies, Report to the Congress, United States General Accounting Office, GAO/RCED-86-66, August 1986.

These simulation models produce a quantitative assessment of cross-impacts within the domain for which they were constructed; that is, the impact of using private access facilities in the provision of public interstate long distance voice services on local telephone companies. The possibility exists to adapt the U.S. models to the Canadian situation and extend them to the full range of cross-impacts between public, private and shared networks. To do so, however, would require extensive research and availability of reliable data.

The primary difficulty with these models is that they estimate revenue impacts based exclusively on cost considerations. As our current research indicates, there are many other factors than price that affect the decision of business users to employ private network facilities. Furthermore, even if additional factors could be included in an expanded model, they would be extremely difficult to quantify. A further difficulty with these models is that they are not future predictive; that is, they indicate the extent of bypass (cross-impacts) at a particular point of time. Consequently, to predict future cross-impacts would require the development of demand models. As noted earlier, the lack of data, particularly for private and shared networks, would make this a difficult task.

It was in recognition of these difficulties that the current methodology was chosen.

2.0 NETWORK CHARACTERISTICS

This chapter presents a description of the network/service categories for which useful data on public, private and shared networks could be obtained. The first subsection describes the various categories, the second presents available data and the third combines all categories by revenues (or revenue equivalent) for comparison purposes.

2.1 Network/Service Categories

Based on the study objectives, influencing factors and events as well as available data, telecommunications networks/services have been segmented into the following five categories for the cross-impact analysis:

1) Public-Switched Telephone Network
2) Public-Switched Data Networks/Services
3) Private Networks - Carrier-Provided Facilities
4) Private Networks - User-Owned Facilities
5) Private Networks - Shared

Public-Switched Telephone Network (PSTN)

This category represents the network of local and long distance switching centres interconnected through transmission facilities and providing circuit-switched connections that can access and be accessed by telephone subscribers through the local

loop. The PSTN is used primarily for voice transmission by residence and business users (on an approximate 50/50 split in terms of derived revenues). The proliferation of modems and terminal devices such as facsimile machines has also resulted in substantial transmission of data and image information over the PSTN. The ratio of local to long distance revenues is in the order of 40/60.

These services are provided by the telephone companies, primarily the members of Telecom Canada, almost exclusively on a monopoly basis. In addition, there are a number of independent telephone companies which also provide PSTN services.

Public Switched Data Networks/Services

This category included packet switched data services offered by the telecommunications carriers. Packet switching is a data transmission method that divides messages into small packets which are independently transmitted through the network and reassembled at the receiving end. This category includes Datapac offered by Telecom Canada and InfoSwitch offered by CNCP Telecommunications, as well as services based on the packet switched networks such as Envoy 100, iNet 2000, etc.

Private Networks - Carrier-Provided Facilities

Private networks considered in this category are based on facilities leased from carriers. Such networks may be used for

both voice and data applications. This category focusses on the private line services offered by the telecommunications carrier, e.g., Telecom Canada, CNCP Telecommunications, Telesat Canada, etc. Private line service provides a dedicated communications channel between terminals in the same or different exchanges. Private line voice services may be provided in three ways:

1) As tie trunks connecting customer PBXs or Centrex switches in different exchanges.

2) As foreign exchange lines connecting a customer terminal in one exchange to a telephone company central office in another exchange; and,

3) As off premises extensions connecting a customer telephone in one exchange to a PBX in the same or another exchange.

The category also includes dedicated analogue and digital data circuits, (i.e., Dataroute, Infodat, Megaroute, etc.). Also included are carrier-provided private line facilities which are resold. In this regard, resale involves the furnishing on a commercial basis of communications services by an enterprise using facilities obtained under tariff from a telecommunications company.[4]

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[4] Competition in Public Long Distance Telephone Service in Canada, Federal-Provincial-Territorial Task Force on Telecommunications, December 1988, p.D-12.

Private Networks - User-Owned Facilities

This category includes all circuits owned and managed by users, i.e., not owned by telecommunications carriers. Such circuits may form components of private networks which are primarily carrier-provided, e.g., short-haul fibre optic or microwave links, or they may in fact be much larger long-haul standalone microwave networks such as those owned by operated by the hydro companies for telecontrol purposes. To build and operate microwave facilities for broadcast or telecommunications purposes, requires that the owner obtain a license from the Department of Communications.

Private Networks - Shared

This category involves the use on a shared basis by more than one customer of a single tariffed service offered by a telephone company.[5]

2.2 Network Usage Data

This section provides historical data as well as general growth trends for each of the five categories. The primary source of the data was Statistics Canada which publishes telecommunications statistics on an annual basis. Data at lower levels of disaggregation, i.e., by specific private line or data service, are not available in the public domain. Hence, the

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[5] Ibid, p.D-13.

reason for choosing the five broad network categories. However, these categories do serve the purpose of illustrating the relative demand amongst interacting network/service categories for purposes of gauging cross-impacts in the analysis stage of the study.

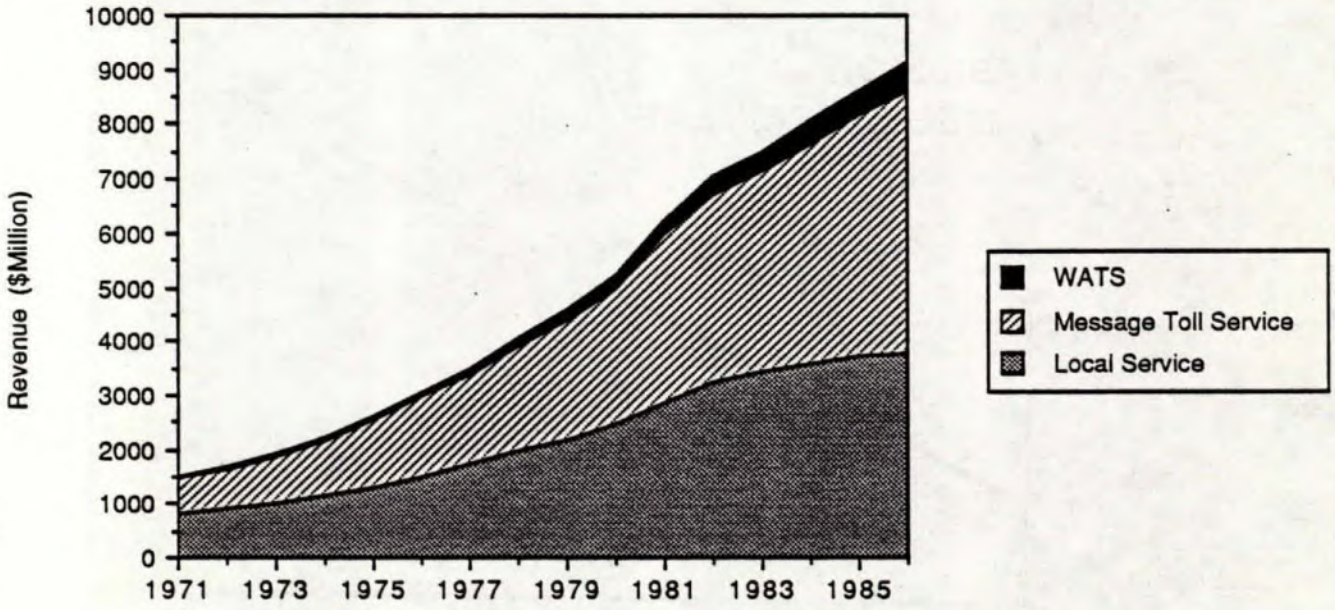
It should be noted that annual revenues are generally used in this study as a proxy for demand. While this is in part due to the lack of available specific demand data, revenues also serve as a common measure with which to illustrate the relative magnitude of the categories.

Public-Switched Telephone Data

Exhibit 2-1 presents 1971 to 1986 total actual public-switched telephone network revenues, sub-divided into three categories: local service, message toll service (MTS) and Wide Area Telephone Service (WATS). The data are presented in tabular form in Appendix D-1 along with the relevant assumptions. The curves in this exhibit illustrate that MTS and WATS revenues have been growing at a much higher rate than local revenues, particularly during the 1976 to 1986 period.

Exhibit 2-2 presents a 1987 Bell Canada ten-year forecast of message toll growth in messages/year. This exhibit, which uses a logarithmic scale, illustrates that Bell Canada is expecting the rate of growth of toll messages to increase during the 1987 to

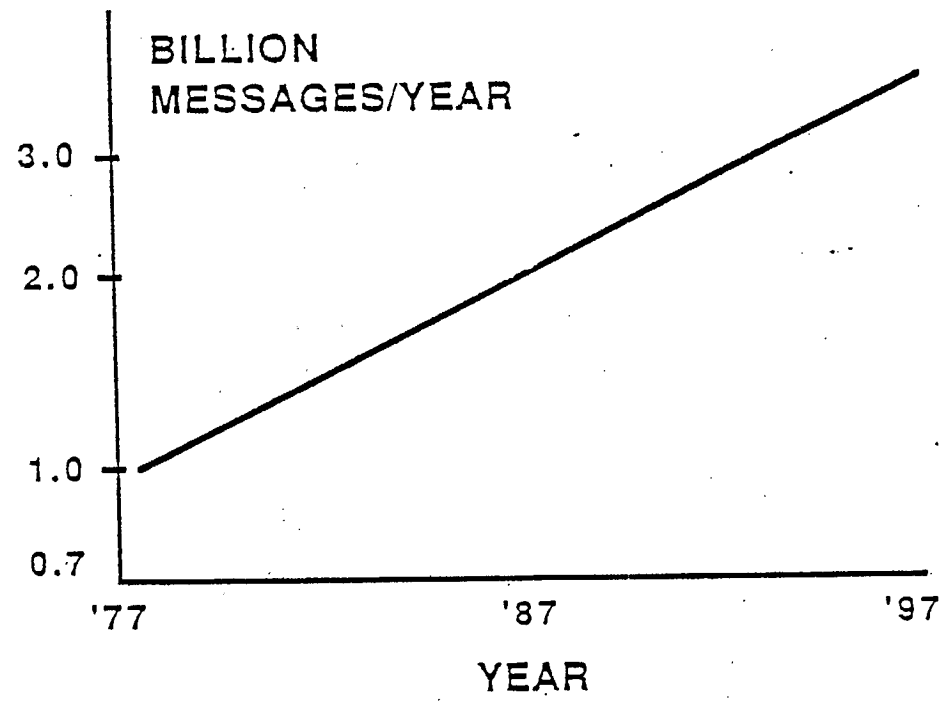
Exhibit 2-1: Public Switched Telephone Network Revenues



Source: Statistics Canada, NGL Consulting
Note: 1984 data unavailable, figures are estimates

Exhibit 2-2

Message Toll Growth



Source: Evolutionary Impact of New Communications Services on Future Fixed Service Spectrum Use, D.A. Carruthers, Bell Canada in Spectrum 20/20, A Symposium on Spectrum Usage: Future Directions in Canada, Radio Advisory Board of Canada, Montreal, May 12-13, 1987.

1997 period compared to the previous 10-year period.

Public Switched Data Services

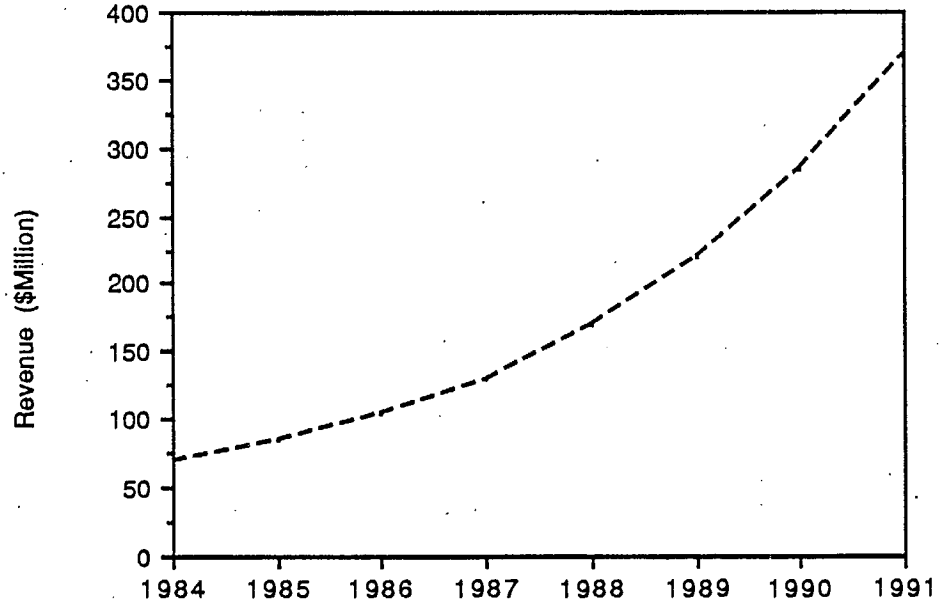
Exhibit 2-3 presents 1984 to 1991 total actual and projected public-switched data revenues. The revenues shown are for Datapac and Infoswitch packet switching networks as well as the more recent electronic mail, intelligent network and enhanced services based on these networks. The data are presented in tabular form in Appendix D-2 along with the relevant assumptions. The high rate of growth in public switched data services is considered to be related to the proliferation of work stations, decentralization of computer processing in organizations as well as a high growth rate in the information services sectors of the economy in general.

Exhibit 2-4 presents a 1977 Bell Canada Datapac growth forecast in billion packets per month. The logarithmic scale used in this exhibit illustrates that exponential growth in Datapac network usage can be expected.

Private Network Revenues - Carrier Provided Facilities

Exhibit 2-5 presents 1971 to 1986 total actual private line revenues sub-divided into two categories, local and interexchange. The data are presented in tabular form in Appendix D-3 along with the relevant assumptions.

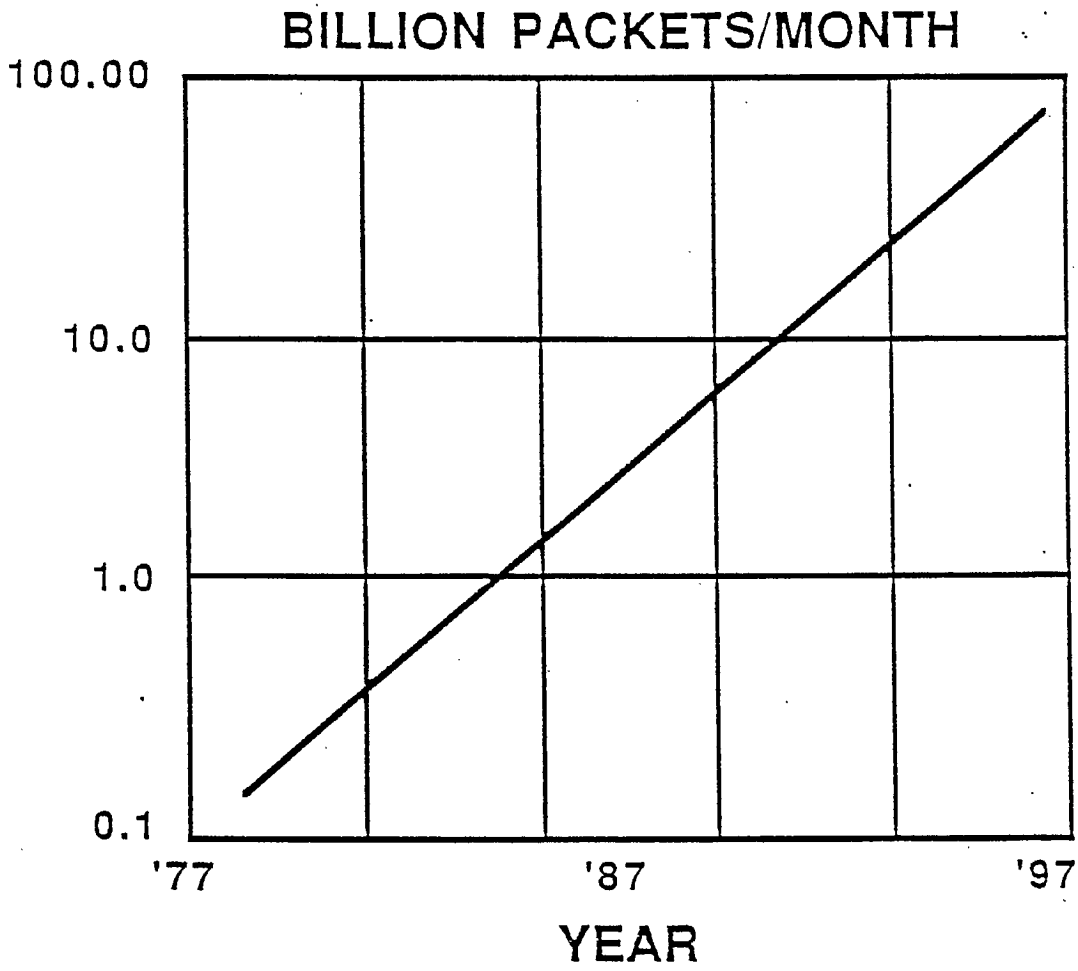
Exhibit 2-3: Public Switched Data Service Revenues



Source: Evans Research (1988-91)
NGL Consulting (1984-87)

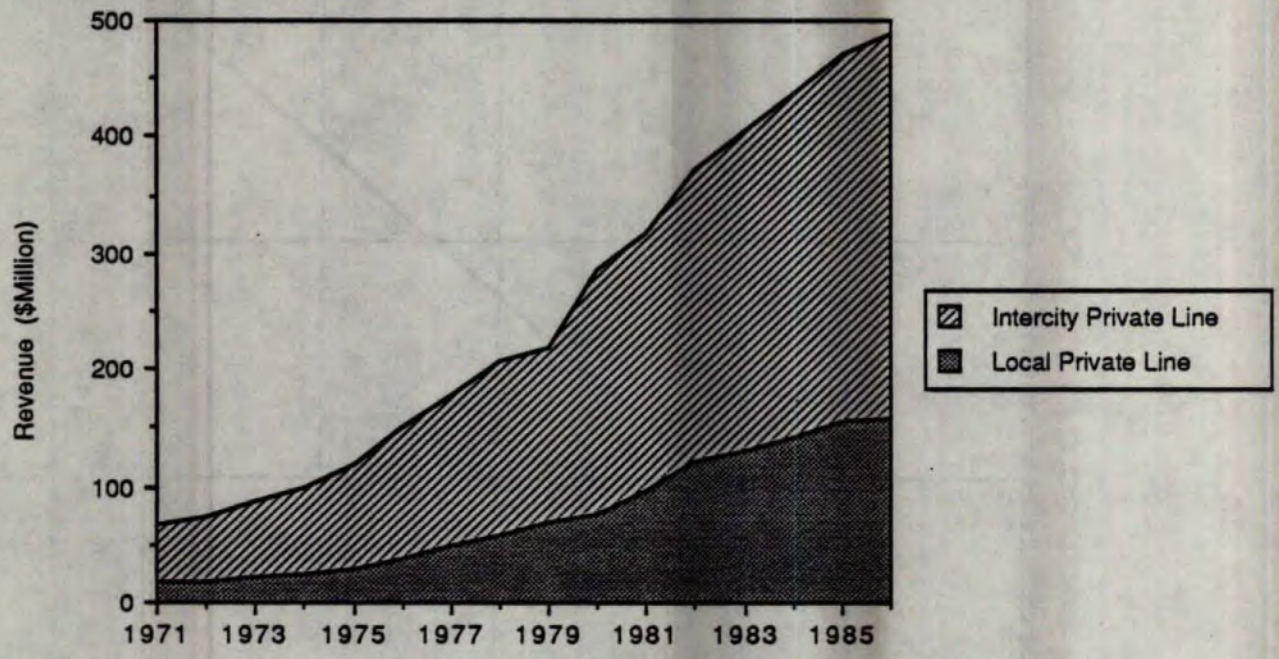
Exhibit 2-4

Datapac Growth



Source: Evolutionary Impact of New Communications Services on Future Fixed Service Spectrum Use, D.A. Carruthers, Bell Canada in Spectrum 20/20, A Symposium on Spectrum Usage: Future Directions in Canada, Radio Advisory Board of Canada, Montreal, May 12-13, 1987.

Exhibit 2-5: Private Network Revenues - Carrier Provided Facilities



Source: Statistics Canada, NGL Consulting
Note: 1984 data unavailable, figures are estimates

This exhibit illustrates that private line services are currently growing at an overall rate of approximately 5 percent, down from the 10 percent growth experienced in the early 1980s.

The data, however, do not reflect the difference in growth rates between voice and data dedicated circuits. Our research indicates that voice circuit revenues are currently growing at less than 5 percent annually while data circuit revenues are growing at 10-15 percent annually.

Private Networks - Used Owned

Exhibit 2-6 presents a table which identified the approximate numbers of organizations which have obtained private commercial microwave licenses as of January, 1989, by industry sector. The source data for this exhibit were obtained from the DOC spectrum licensing data base. DOC has estimated that these private commercial licenses account for approximately 15 to 20 percent of the total microwave usage in Canada. The majority of microwave usage is by the public commercial telecommunications carriers.

DOC has also estimated that usage of these private commercial microwave facilities represents approximately $50 to $60 million in equivalent annual private line revenues that would have been levied by the telecommunications carriers.

Exhibit 2-6

Number of Organizations with Private Commercial Microwave Licenses

Sector	Approximate Number of Organizations
Transportation	9
Resources	22
Hydro	11
Mobile Communications	4
Government	17
Other Non-Broadcast	7
Broadcast and Cable	350
Total	420

Source: Private Microwave Licensee Network Report by District Office, Report Prepared by Department of Communications for this study, February 1, 1989 (Analysis by NGL Consulting Ltd.)

While data concerning growth in private commercial microwave networks are not available in the public domain, those users interviewed indicated that the number of large user-owned networks is not growing significantly.

More recently the private user-owned network category has also involved fibre optics, particularly at the local level. Provided that a user can obtain access to rights-of-way, there are no restrictions on owning fibre optic cables for private network use. Interviews with users revealed that there is a trend towards increased user-provided fibre optic facilities, particularly in remote areas (for example, by resource sector or users), as well as in larger urban centres where there is a requirement to link offices together.

Private Networks - Shared

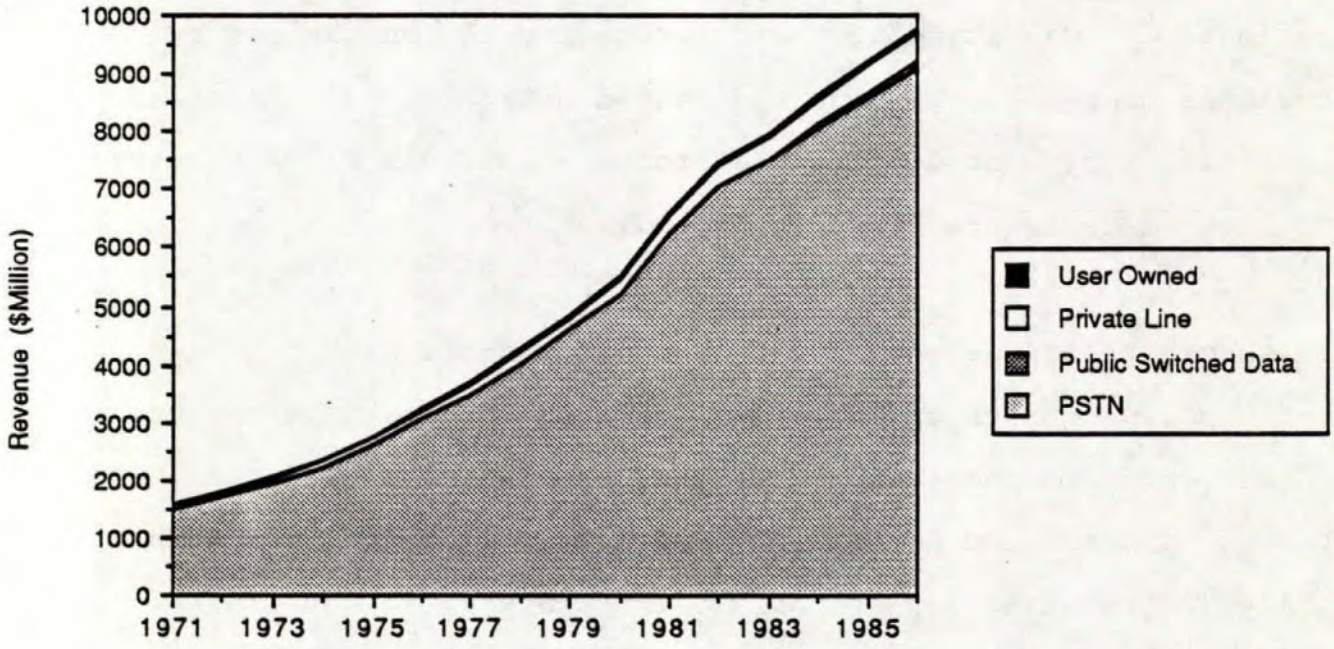
Specific data concerning this category were not available for the study. However, at present, the number of users sharing intercity private line facilities under the current sharing rules is considered to be negligible.

2.3 Comparison of Network/Service Categories

Exhibit 2-7 presents the revenues for all five network/service categories on one graph. This exhibit illustrates that all other categories are dwarfed by public network revenues. For example, 93.4 percent of all revenues in

1986 were generated by public network services. Thus, even very dramatic shifts in the revenues generated by other categories, only 6.6 percent in total, would have only a small cross-impact on public network revenues. Other categories would still only account for approximately 13 percent of total revenues assuming that business usage accounts for approximately 50 percent of PSTN revenues.

Exhibit 2-7: Total Public and Private Network Revenues



Source: Statistics Canada, NGL Consulting
Note: 1984 data unavailable, figures are estimates

3.0 IMPACT OF FACTORS AFFECTING THE SUPPLY AND DEMAND OF PUBLIC, PRIVATE AND SHARED TELECOMMUNICATIONS NETWORKS

From the interviews with experts and independent research work conducted by the project team, a number of factors were delineated which affect the supply of and demand by business for public, private and shared telecommunications networks. Subsequently, these factors were analyzed by the project team to estimate the magnitude of their future impacts on the use by business of public, private and shared networks. The detailed analysis is presented in tabular form in Appendix E. A summary of interviews is presented in Appendix F.

It should be emphasized that this chapter deals with both the anticipated impacts of individual factors on growth in the use of public, private and shared networks, and the cross-impacts between factors and networks. Chapter 4.0 isolates from this analysis the cross-impacts only. The analysis in the present chapter and the cross-impacts analysis in Chapter 4.0 together form the basis for predicting the future relative use of public, private and shared telecommunications networks. Factors have been sub-divided into three categories: demand-influencing, supply-influencing and policy/regulatory. The following sub-sections discuss factors and their impacts according to these three categories.

3.1 Impact of Demand-Influencing Factors

The following presents an analysis of demand-influencing factors on the use of public, private and shared telecommunications networks.

Factor D1 - Pricing

Our research indicates that there are five key factors under this category which influence the use of public, private and shared networks:

D1.1 Decreasing Real Unit Prices

D1.2 Decreasing Long Distance Prices Relative to Local

D1.3 Phase III Cost-Based Pricing of Competitive Network Services

D1.4 Use of IXVG and 9.6 Kbps as a Voice/Data Benchmark Price

D1.5 Higher Canadian Prices than U.S. Prices

A comparison of the consumer price index with the telephone price index indicates that the price of telephone service has declined in real terms from 1971 to 1987 (Exhibit 3-1). Telephone service in 1987 was approximately half the price in real terms of that in 1971. It is likely that the main source of these price reductions has been productivity improvements brought about by technological change which should continue into the next decade.

Exhibit 3-1

Consumer Price Index Versus Telephone Price Index

Year	Consumer Price Index	Telephone Price Index	TPI/CPI
1971	100.0	100.0	1.00
1977	160.1	123.4	0.77
1978	174.3	127.9	0.73
1979	190.3	131.4	0.69
1980	209.7	134.5	0.64
1981	235.8	146.2	0.62
1982	261.3	163.0	0.62
1983	276.4	173.5	0.63
1984	288.4	177.9	0.62
1985	300.0	180.0	0.60
1986	312.3	179.4	0.57
1987	325.9	174.1	0.53

Source: Annual Report 1987-1988, Canadian Radio-television and Telecommunications Commission, p.57.

In addition, the telephone industry has experienced substantial rate reductions for long distance voice services, both for domestic and international calling in recent years. For example, Bell Canada's long distance rates for intra-company and transCanada long distance calls were reduced by approximately 30% between 1986 and 1988.[6] Such rate changes have generally not been accompanied by local rate increases. They were mandated by regulators as a result of a variety of factors, one of which is generally considered to be a move toward cost-based pricing. This trend is also likely to continue into the next decade.

In the area of private line pricing, prices have generally been increased for the federally-regulated telephone companies either in response to the introduction of tariffs to permit sharing and resale to provide non-MTS/WATS services or to ensure compensatory rates under Phase III costing for Bell Canada and B.C. Tel.

Such private line pricing trends may, however, only be temporary in Canada since the U.S. experience indicates that digital private line rates have continued to fall as long distance voice rates have decreased. Only analog voice grade (IXVG) private line have shown some increases. These price trends in the U.S. are shown in Exhibit 3-2 for a 1500-mile T-1 interoffice circuit in terms of equivalent per voice grade circuit costs, assuming in

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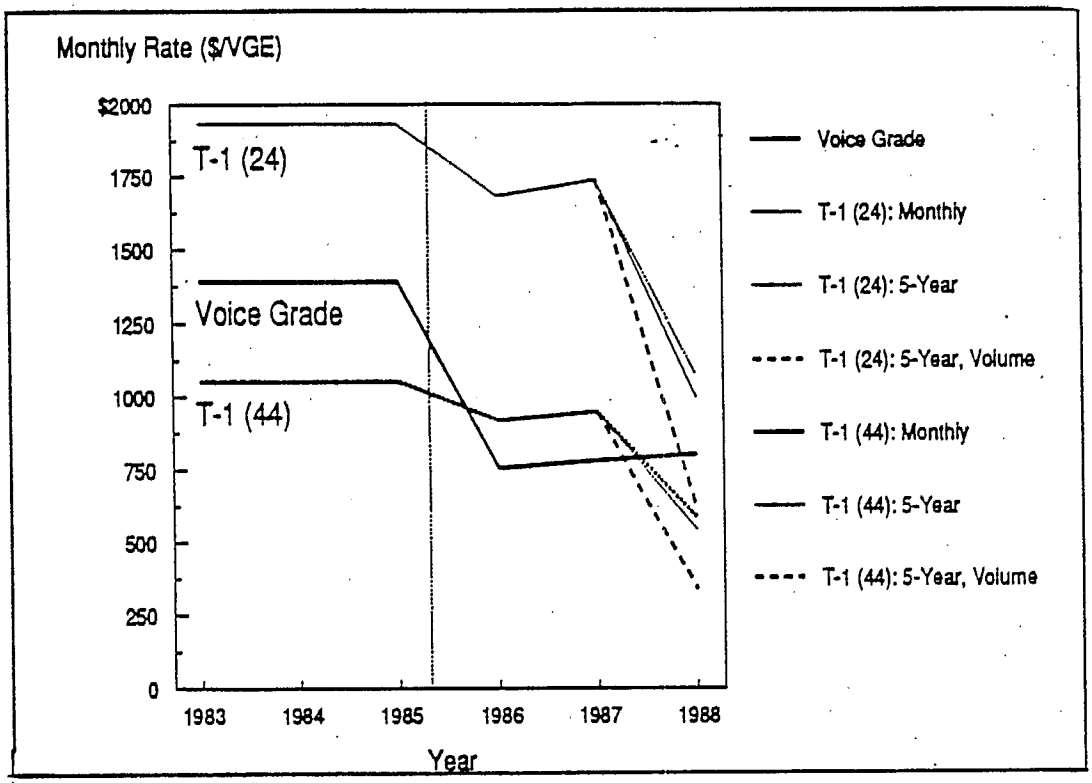
6 Annual Report 1987-1988, Canadian Radio-television and Telecommunications Commission, p.53.

Exhibit 3-2

Rates for AT&T T-1 Service



Source: Competition in Public Long Distance Telephone Service in Canada, Federal-Provincial-Territorial Task Force on Telecommunications, Consulting Report 2, December 1988, p.58.

one case multiplexing of 24 voice grade channels and in another case multiplexing of 44 voice grade channels. AT&T's analog voice grade service is also included for comparison.

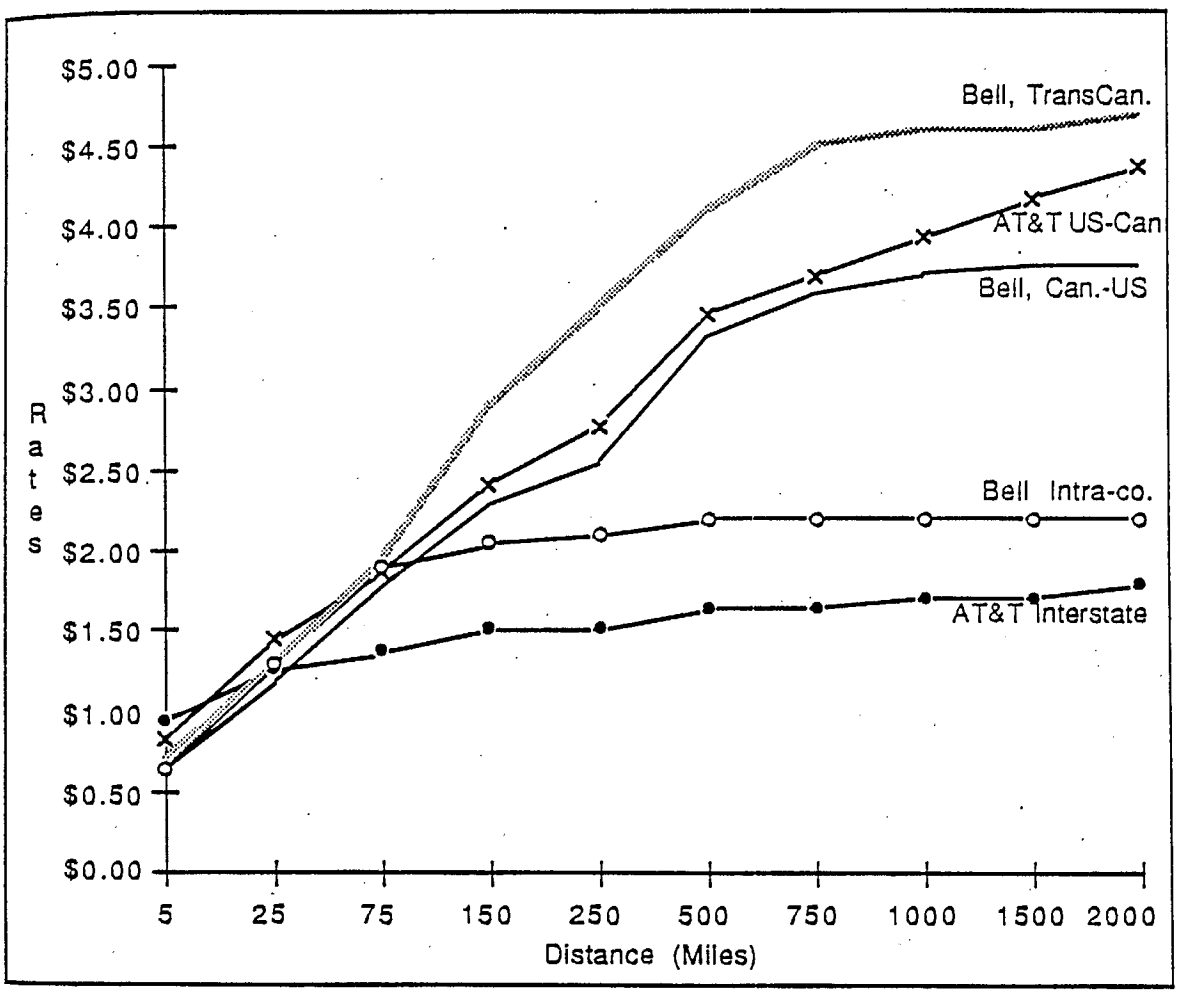
A number of interviewees indicated a concern that Canadian prices for long distance services are higher than those in the United States. The price differences in effect as of 1 April 1988 are illustrated in Exhibit 3-3. AT&T's interstate rates at long-haul distances were approximately half of Bell Canada's transCanada rates and marginally lower than intra-company rates. However, Bell Canada's Can-U.S. rates were actually lower than the equivalent U.S.-Canada rates for AT&T.

Concerns were also expressed about higher Canadian rates for data services. In this case, interviewees focussed particularly on Canadian T-1 rates which were quoted as being approximately three times higher than U.S. rates. Interviewees perceived that this situation exists because of the maintenance of an historical pricing relationship between IXVG private line services and 9.6 Kbps data services rather than a more realistic relationship to T-1 service (e.g., 64 Kbps).

The impacts of these pricing factors on the use of public, private and shared networks is estimated to have a high negative to medium positive impact on public network services over the next decade. As real prices drop, which, as indicated, should

Exhibit 3-3

Distance Sensitivity of Current Canadian and U.S. Directly Dialled Long Distance Rates * (5-minute daytime call, Cdn. Dollars)



* Bell Intra-co. and TransCan. rates as at 1 April 1988; Bell Can.-US rates as at 1 July 1988; AT&T interstate rates as at 1 January 1988; AT&T US-Can. rates as at 15 April 1988. AT&T rates are restated in Canadian funds, $1 U.S. = $1.25 Cdn.

Source: Competition in Long-Distance Telephone Service in Canada, Federal-Provincial-Territorial Task Force on Telecommunications, December 1988, p.125.

continue over the decade, demand for all services will increase. Decreasing long distance rates will also stimulate demand for long distance services. Additionally, the decreasing margins between long distance services and private line services, if continued, would contribute to long distance growth and decrease the demand for private line services (i.e., decreasing margins change the cross-over point between the two service categories). Continued pricing of T-1 services at current rates could significantly negatively impact the use of T-1 private line services compared to possible demand-based growth. Higher U.S. rates for long distance services could have a small negative impact on public network services as users bypass Canadian services to use cheaper U.S. services. Concurrently, some stimulation of private line services would occur to enable users to access U.S. long distance carriers.

Factor D2 - Rapid Growth in Information Technologies

One of the fundamental factors driving the demand for business communications has been the growth in the use of information technologies. A recent article in Fortune magazine, for example, indicates that significant advances in information technologies -computers, imaging, communications and networks - offer greater opportunities than ever before, at less risk than ever before, for substantial productivity gains and strategic

business advantage.[7]

Increasingly sophisticated microcomputers offering vast improvements in processing and storage capability at decreasing costs have proliferated throughout government and business. It is anticipated that today's microcomputers and intelligent terminals will emerge as versatile, multi-functional workstations, utilized for personal computing, communications and for accessing a variety of computer databases.

Within the context of the increasing use of computing capabilities within government and business, our research indicates four trends which affect the growth of telecommunications networks:

D2.1 More Distributed Processing

D2.2 Higher Bandwidth Requirements for Larger Files and Quicker Response Times

D2.3 Pre-processing of Information

D2.4 Requirement for More Mobile Telecommunications

Increasingly, organizations are moving to distributed processing, i.e., placing substantial computing power directly in the hands of users. As a result, end-user computing will dominate all

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[7] Harnessing Information Technologies, Fortune, July 4, 1988, Advertising Supplement.

other forms of computing in the next decade. However, the role of the central information organization, rather than shrinking, is expected to expand enormously. The central organization will be the repository for organization-wide information from which managers will demand more and more electronic corporate information through their workstations.

How quickly organizations move to this distributing processing environment will demand, in part, on telecommunications costs and capabilities. While our interviews indicated that this trend is occurring, we also perceived from some users that telecommunications costs act as a barrier to decentralization of computing facilities. Some users overcome this barrier through the use of private networks - a trend which would likely increase if Canadian T-1 rates were to be decreased.

A growing trend observed amongst users was a requirement for large bandwidth to transmit larger files with quicker response times. It can be anticipated that users will require the same low response times for large files that are currently expected in interactive transactions involving only a few characters of information (i.e., several seconds). This will require large bandwidths to be directly available to users (56 Kbps and above).

Technological advances will be required, and to some extent have already occurred, to assist users to deal with large volumes of

information. Flexible imaging devices are being developed which facilitate the input of printed information. Input will also be enhanced with the perfection of voice recognition devices. Pre-processing of information from computer databases will also be required to reduce information to manageable dimensions. Expert systems have already demonstrated their usefulness to decision-makers in this respect. A number of major insurance companies, for example, use expert systems to guide underwriters and agents through the underwriting process. Expert systems can capture, store and distribute the expertise of senior managers; networking can make this knowledge an organization-wide resource, available to anyone anywhere in the organization.

While the above indicates a trend towards making information available at the desktop, there is also a trend towards more mobile communications. In a growing number of organizations, users require access to voice, data and text while they are away from the office. This requirement has spurred the growth of cellular mobile telephone services, which will continue to expand and include other areas such as data communications and facsimile.

These trends, particularly those relating to the requirements for higher bandwidth and faster response times and the increase in distributed processing, will increase the demand for all network categories. Demand will be high for data communications, public

network services and less so for public voice services, primarily because of the anticipated growth in computer information transmission requirements. Stimulation in the use of private and shared networks should also occur as organizations find these network solutions to be cost effective and efficient. Inherently, there are none or minimal cross-impacts created by this category of impacts that would cause business users to migrate to private or shared networks, other than that as volume grows more organizations will be able to afford private and shared networks. Such cross-impacts would, in any case, be minimal compared to the growth in public network services.

Factor D3 - Increased User Management and Control of Telecommunications Facilities

Our research indicates that, in recent years, there has been increased emphasis amongst business users to manage and control their own telecommunications facilities. This manifests itself in terms of the following three key trends:

D3.1 Increased emphasis on telecommunications as a strategic asset compared to user costs in the decision

D3.2 Increased demand by users for quality, features and flexibility

D3.3 Control of telecommunications costs

Our interviews indicated that telecommunications and information systems are taking on a new importance for Canadian business. Until recently, business communications and data processing played subservient roles in most organizations. Companies are now realizing that telecommunications and information systems can be used as a strategic tool to increase competitiveness - get closer to the customer, maximize the use of their resources and maintain competitiveness, especially internationally. For those companies who have adopted this approach, fast reliable access to market information is treated as a competitive weapon.

A 1985 article in Fortune indicates this same trend has occurred in the United States.[8] In the U.S., the trend coincided with increased competition in the telecommunications industry which stimulated the development of supply options. In addition, advancing chip technology, the spread of computers, digitization of the network, flexible software tools and increased technology literacy were seen as driving factors. External non-technological events, however, had more to do with turning telecommunications and information technologies into a strategic force. These included the oil crisis which prompted major changes in the global economy, increased international competition and de-regulation in basic industries. Players in

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[8] Business Communications, Fortune, 1985, Advertising Supplement.

energy, transportation, banking and financial services were all actively looking for tools of differentiation.

As a consequence of the increasing importance of telecommunications, higher level management is becoming involved. Highly sophisticated telecommunications managers are being hired by business and decision-making is occupying more senior management time. Telecommunications management has moved from emphasis on operational efficiency to one of obtaining strategic advantage.

The consequence for carriers is that business users are making demands for higher quality, more features and greater flexibility in the communications systems and services. Our interviews indicated that many users perceive the carriers not to be responsive, particularly in a timely, cost-effective manner to their requirements, and consequently they have either adopted private line networks or are considering doing so. In most of these cases, users lease transmission facilities from the carriers and add their own terminal and switching equipment to create sophisticated private networks. Private networks are seen by users as allowing them to manage and control a critical resource, particularly in terms of service quality, reliability, security, diversity and access to information.

There is an increasing trend amongst users for more flexibility and sophistication in network usage. Users wish to control the dynamics of the network; for example, to use their networks for voice communications during the business day and data communications at night or to acquire bandwidth on demand. Some users have or are contemplating leading-edge innovation in network design; for example, private packet switching networks, intelligent networks or private ISDNs.

It is interesting to note that this trend is occurring even though users generally prefer one end-to-end supplier and that the price gap between public and private services has been narrowed. Thus, user management and control to achieve strategic advantage is a strong motivation towards the use of private networks. In addition, since telecommunications usage is increasing there is also a strong motivation to control costs.

Another class of customer has a requirement for specialized networks that are not normally provided by the carriers. For example, various hydro electric companies, the police and some provincial government departments fall into this category. Normally such networks are built from user-owned transmission and switching facilities. Such specialized networks do not have an impact on public network services or other private or shared networks since they represent new applications which would not otherwise exist. The only exception would be the use of such

private networks for carriage of administrative traffic beyond what these networks were originally designed for. In a more liberalized policy environment the impact of such networks could increase through interconnection arrangements, sharing and the resale of excess capacity.

The primary direct impact of increased user management and control is on private network use. Increased demands for quality, features and flexibility will lead to substantial use of private networks, both user-owned and carrier-provided. The impact, we estimate, will be highest in regard to private line data networks and relatively lower for private line voice networks since the emphasis is on access to information rather than voice communications. The need to control costs is an important factor in choosing private networks but will be of decreasing importance as long distance rates are decreased.

The cross-impact of private network use could impact negatively on the demand for public network services. These cross-impacts effects are, however, estimated to be low considering the relative magnitudes of the public and private telecommunications networks. The increased emphasis on telecommunications as a strategic tool could actually stimulate the demand for both public and private networks, making it difficult to ascertain any net negative effects from the cross-impacts.

In the area of shared private line networks there has been limited growth to date. Our interviews indicated that growth in shared networks to provide non-MTS/WATS services is limited by regulatory constraints. Some shared networks amongst natural communities of interest do, however, exist; for example, the shared networks used by the airlines, stock exchanges, libraries, universities, etc. An interesting phenomenon in shared networks is developing in the U.S. and is also beginning to emerge in Canada. A recent report on trends in the U.S. telecommunications industry describes the development of vertical value added networks which link suppliers, vendors and customers in a vertical fashion.[9] Such networks specifically cater to the requirements of the industry sector in which they are implemented and are part of the thrust to use telecommunications as a strategic business tool described earlier. Telecommunications and information processing are used to facilitate information flows, strengthen customer-supplier relationships and create financial linkages. In the U.S., where flexibility in provisioning exists, such networks tend to be built on a shared, private network basis. The author of the report argues that this could have a substantial negative impact on the provisioning of public network services.

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[9] Trends in Telecommunications Networks: Regulatory Issues and the Outlook for the U.S. Information Economy, William H. Davidson, University of Southern California, April 1988.

As indicated, some evidence of this same approach to customer linkages through information networks is occurring in Canada. A primary example is Electronic Data Interchange (EDI) which links suppliers, the transportation industry and customers within the context of just-in-time inventory control systems. Our interviews also indicated a similar initiative on the part of carriers to develop an applications-oriented approach linking key players in particular industry segments. Carriers could, for example, provide the equivalent to the vertical value added networks described above on the public network, perhaps with the use of virtual private networks, and could counter the trend observed in the U.S. to the use of private line networks.

Factor D4 - General Economic Factors

Our research indicates that there are three general economic factors that influence the use of public, private and shared networks:

D4.1 Growth in Population, Employment, Gross Domestic Product and Housing Starts

D4.2 Demographics of Business Growth

D4.3 Free Trade (Stimulation of Economic Activity)

Exhibit 3-4 presents statistics on various economic and demographic indicators that have been used by carriers to

Exhibit 3-4

Economic and Demographic Indicators and Projections to the Year 2001

Year	Population	Employment	Gross Domestic Product 1981 Prices	Housing Starts	Number of Households
	(1,000)	(1,000)	($mill.)		(1,000)
Actual					
1971	21,568	8,104	232,137	233,653	6,041
1972	21,853	8,344	245,441	249,914	6,266
1973	22,142	8,761	264,369	268,529	6,491
1974	22,123	9,125	276,006	222,123	6,716
1975	22,731	9,284	283,187	231,456	6,941
1976	22,993	9,477	300,638	273,203	7,166
1977	23,262	9,651	311,504	245,724	7,389
1978	23,534	9,987	325,751	227,667	7,612
1979	23,810	10,395	338,362	197,049	7,835
1980	24,088	10,708	343,384	158,601	8,058
1981	24,343	11,006	355,994	177,973	8,282
1982	24,545	10,644	344,543	125,860	8,424
1983	24,749	10,734	355,445	162,645	8,566
1984	24,955	11,000	377,865	134,900	8,708
1985	25,162	11,311	395,217	165,826	8,850
1986	25,354	11,634	407,736	199,785	8,992
1987	25,625	11,861	424,136	215,340	9,082
1988	25,923	12,233	443,375	222,562	9,244
Projected					
1991	26,527	13,015	485,939	206,000	9,910
1996	27,760	14,382	563,689	195,000	10,692
2001	28,813	15,892	653,880	180,000	11,474

Sources:

Population Projections: see Population Projections for Canada, Provinces and Territories, 1984-2006, Statistics Canada, May 1985. Selected series adjusted using 1986 Census results (see Medium and Long Term Projections of Housing Requirements in Canada, Canada Mortgage and Housing Corporation, prepared by Clayton Research Associates, December 1987).

Employment Projections: based on assumptions used in Canada's Economic Prospects: Looking Ahead to the 1990s, Part of the February 10, 1988 Federal Budget, Department of Finance.

GDP: based on assumptions used in Canada's Economic Prospects: Looking Ahead to the 1990s, Part of the February 10, 1988 Federal Budget, Department of Finance.

Housing Starts Projections: see Medium and Long Term Projections of Housing Requirements in Canada, Canada Mortgage and Housing Corporation, prepared by Clayton Research Associates, December 1987.

Number of Households: see Medium and Long Term Projections of Housing Requirements in Canada, Canada Mortgage and Housing Corporation, prepared by Clayton Research Associates, December 1987.

generally explain the growth in public network services.[10] The exhibit contains historical data from 1971 to 1988 and projected data for 1991, 1996 and 2001. These projections can be interpreted as indicating continued growth in public network services. Such growth, according to these data, would occur at approximately the same rate as the previous two decades.

The demographics of business growth also can affect telecommunications use. It is well known that small businesses have been the net creator of new jobs in the Canadian economy for a number of years. New businesses almost exclusively use public network services since they are generally too small to use private networks. Hence, there is a constant growth in businesses requiring public network services. Such growth can, however, in the short term, be offset by large businesses due to the fact that a relatively small percentage of large businesses generate the majority of revenues for the carriers. A movement of only a few large business customers to private networks can affect the relative use of public versus private networks much more than the growth resulting from small business generation.

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[10] See for example:
Econometric Model of Demand for Customer-Dialled Telecom Canada Message Toll Services, Corporate Revenue Estimates, Bell Canada, July 1984.
Memorandum on Economic Outlook, Demand and Operating Revenues, Bell Canada, 1987.

A third economic factor relates to free trade. Increased trading activity as a result of the free trade agreement will lead to a higher requirement for telecommunications services.

These general economic factors indicate continued growth in all network categories - public, private and shared. Our research indicated that cross-impacts generated by these factors are negligible.

3.2 Impact of Supply-influencing Factors

The following presents an analysis of supply-influencing factors on the use of public, private and shared telecommunications networks. These include factors of a non-policy/regulatory nature, i.e., outside the direct control of governments. This distinction has been made to isolate externally driven factors from those considered in the next sub-section where government can institute changes which directly influence supply.

Factor S1 - Technological Advances

The telecommunications/information processing industry, broadly referred to as the information industry, has experienced substantial technological advances which have profoundly influenced supply. Our research indicates that the following trends/factors are key:

S1.1 Decreasing network unit costs

S1.2 Increasing functionality per unit cost

S1.3 Increasing connectivity/universality

S1.4 Use of digital transmission and switching

S1.5 Increased capacity per unit cost

S1.6 Terminals with increased capacity and lower price

S1.7 Substantial reductions in computing costs (processing and storage)

S1.8 Evolution to ISDN

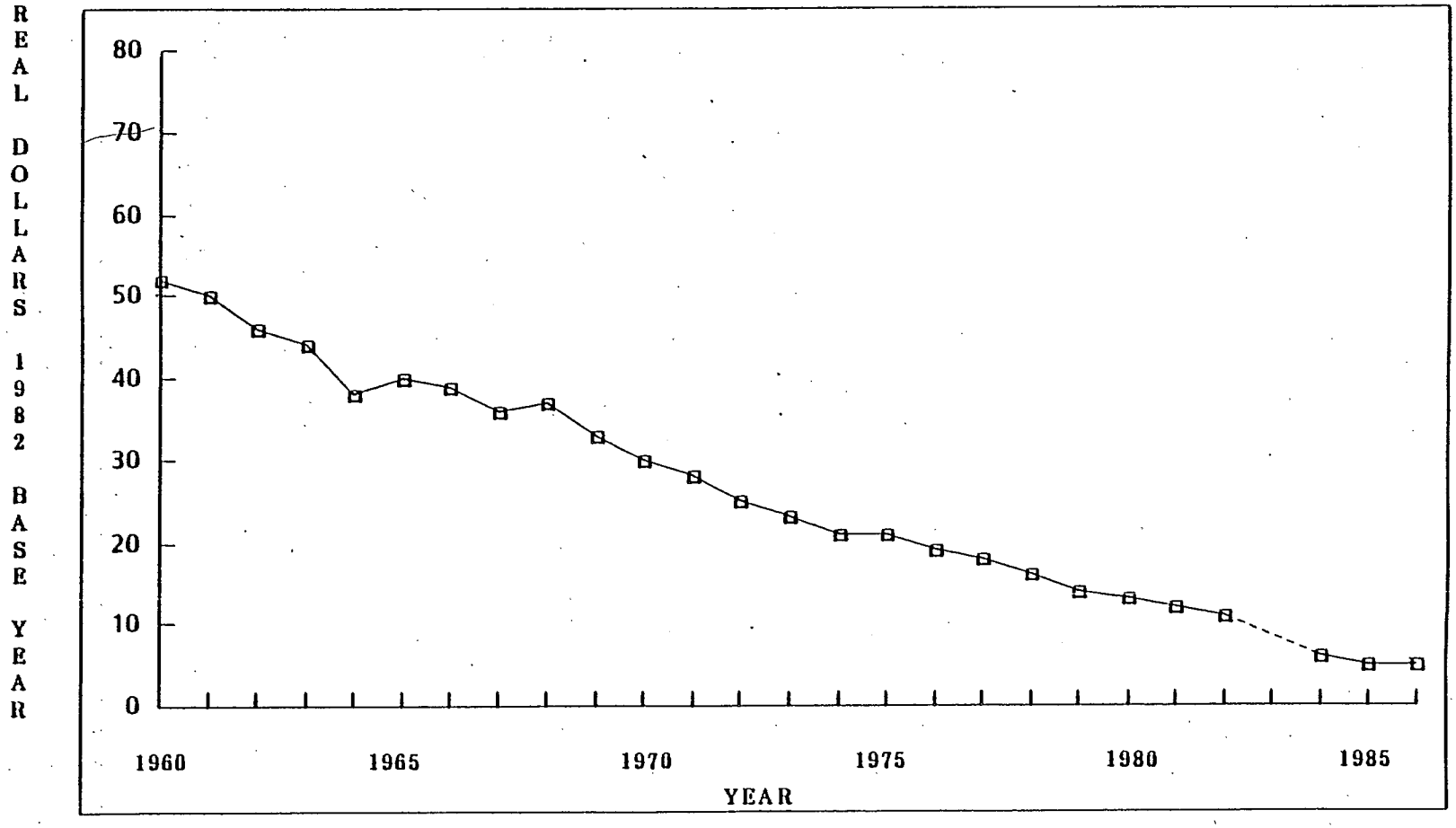
These are well known technological trends which were emphasized throughout our interviews and the workshop. Decreasing network unit costs are illustrated in Exhibits 3-5 and 3-6. The first of these exhibits indicates that AT&T's average investment per circuit fell from approximately $50 U.S. in 1960 to approximately $5 U.S.in 1986. The second exhibit indicates that Bell Canada's real marginal cost per DDD long distance message fell from a relative value of 100 in 1982 to approximately 70 in 1985. There is every reason to believe that with advances in transmission and switching these trends will continue into the 1990s.

Both Canada and the U.S. are moving quickly to digital networks. A report by Bethesda Research Institute, Ltd. for the Consumers' Association of Canada indicates that in 1987 approximately one-third of U.S. switches were digital and that by the mid to late 1990s most telephone company end offices will contain digital

Exhibit 3-5

Average Investment Per Circuit (AT&T)

1960 to 1986



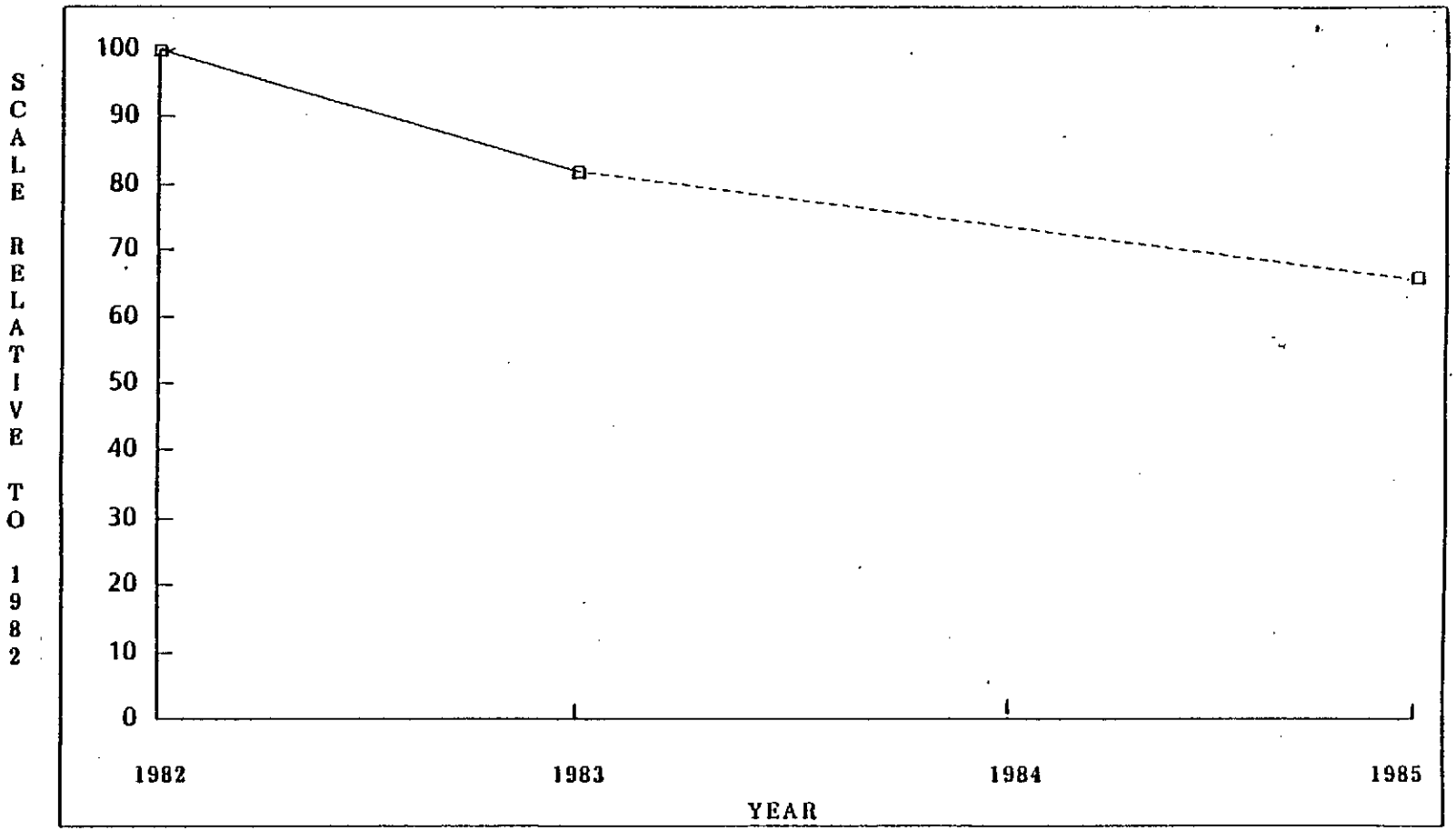
------- Denotes extrapolated data

Source: Competition in Public Long Distance Telephone Service in Canada, Federal-Provincial-Territorial Task Force on Telecommunications, Consulting Report 3, December 1988.

Exhibit 3-6

Real Marginal Cost per DDD Long Distance Message (Bell Canada)

1982 to 1985



* The absolute magnitudes of these data are considered confidential. The relative scale reflects real dollars (1981 base year).

------- Denotes extrapolated data

Source: Competition in Public Long Distance Telephone Service in Canada, Federal-Provincial-Territorial Task Force on Telecommunications, Consulting Report 3, December 1988.

switches.[11] The report also indicates that, in Bell Canada's operating territory, the portion of working lines connected to digital switches increased from 24 percent in 1986 to 30 percent in 1987. By 1992, it is anticipated that 58 percent of lines will have access to digital offices. For B.C. Tel, about 2 percent of local lines were connected to digital switches in 1983, whereas by 1987 this figure had increased to 59 percent. By 1993, B.C. Tel expects to have 93 percent of working lines with access to digital. In terms of costs, the Bethesda report estimates that digital switching costs have fallen 17 percent in the last three years and further decreases can be expected.

These developments are precursors to the implementation of ISDN, which contemplates the provision of end-to-end digital services based on international standards. With ISDN trials currently under way, commercial implementation should occur in the early 1990s and be widespread by the end of the decade, particularly to serve business customers.

In terms of transmission facilities, the key technology in future networks will be fibre optics. Already, U.S. and Canadian carriers are moving to fibre optics in their backbone national and regional networks. Fibre price trends indicate substantial

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[11] Report on Advisory Committee Terms of Reference: ISDN and its Implications for Competition, Bethesda Research Institute, Ltd., Rockville, MD for the Consumers' Association of Canada, November 1988, p.19.

price reductions; from $2.62 U.S. for single mode fibre per cabled fibre metre in 1980 to an expected $0.12 U.S. by 1995. Dramatic price reductions can also be expected in the optical and electronic equipment associated with fibre optics transmission.[12] Further fibre optics network cost reductions can be expected as more sophisticated multiplexing equipment enables greater use of existing fibre optics transmission facilities.

When viewed from the user's perspective, significant increases in capability and reductions in prices have also occurred in terminal and computing equipment. This trend has been driven by computer technology having greater capability (processing and storage) at lower unit costs. The result has been the availability of more sophisticated terminals and a spread of computer equipment through business offices.

Technological advances must be transmitted to users in a tangible manner, for example through price reductions or increased product and service capabilities, to cause an impact on the use of public, private and shared networks. The impact on public network use from decreased network unit costs and associated factors, for example, will depend largely on whether or not cost reductions are passed to customers. If in the past, prices were not cost related and consequently technological advances did not

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[12] Ibid, p.24.

produce direct demand-related signals. In areas where users experience the direct results of technological change, for example, terminals with increased capabilities and lower prices, stimulation of public network use has been high. The stimulation in public network use which has occurred because of advances in facsimile machines and their proliferation provides a graphic example of this type of growth. The evolution to ISDN provides a further example where growth in the use of public networks could occur as a result of service innovation and cost reductions. Whereas some growth can be expected because of new services, substantial stimulation will depend on prices of facilities and services.

In the area of user-owned private and shared networks the situation is different. Users have the option of building their own networks (barring other considerations which may limit their actions) and incorporating technological advances in transmission, switching and terminal equipment. Our analysis indicates, however, that, except for business users with specialized requirements, business users generally will only choose this route if the benefits of technological advances are not passed to them through other means.

The impact of technological advances on the use of carrier-provided private networks is more complex. As with public networks, technological change will have little effect if not

passed to users through price changes. Alternatively, technological change coupled with a driving force such as competition could lead to substantially lower prices and increased capabilities, as the U.S. experience demonstrates in T-1 pricing, and lead to much greater use by business. This would also be affected by public network service prices and service capabilities. In other words, a complex set of cross-impacts would be in operation.

Factor S2 - Increasingly Sophisticated Public and Private Network Capabilities

A major trend in network design, both carrier-based and private, is the addition of intelligence which greatly expands network capabilities. The key factors determined in our research were:

S2.1 Common Channel Signalling

S2.2 Software Defined Networks

S2.3 Availability of Value Added/Enhanced Services

Canadian carriers are currently planning the implementation of Common Channel Signalling System Number 7, commonly known as Signalling System Number 7 (SS#7), to exploit the computer and database capabilities of new digital switches. SS#7 combined with D channel signalling in ISDN will provide end-to-end signalling and enable the provision of a wide range of new

services. SS#7 is an out-of-band signalling system which in itself allows for faster call set up and results in more efficient and flexible management and use of networks.

One of the true innovations in network design in recent years is the development of software defined networks. These networks use common channel signalling and exist in a virtual form on public networks. They may also be provided on private networks with the appropriate capabilities. The U.S., having proceeded with an earlier form of common channel signalling, is ahead of Canada in developing such networks. When software defined networks become available in Canada, users will be able to configure virtual private networks that could in effect replace dedicated private networks. In particular, software defined networks could be used by carriers to provide the features and functionality of private networks to a broad range of customers without the necessity of using dedicated facilities as in current private networks. Hence, the development of software defined networks will have a positive, rather than a negative impact on the ability of carriers to provide public networks.

Value added or enhanced services have been defined by the CRTC as "...an offering over the telecommunications network which is more than a basic service." A basic service in contrast has been defined as "...one that is limited to the offering of transmission capacity for the movement of information." Enhanced

services provided by carriers or enhanced service providers offer sophisticated voice and data services to users. Examples include voice mail, electronic mail, iNet 2000, Terminal-to-Host Concentration, etc. In a more general sense, the vertical value added networks referred to earlier fall into this category.

In terms of direct impacts, SS#7 and software defined networks add functionality which will increase the use of public, private and shared networks, i.e., new services will be offered which did not previously exist. Additionally, depending on the price of public-network-based software defined networks versus private networks, carriers should be able to lessen the migration to private networks and effectively retain users on the public network.

Factor S3 - Availability of Local Access Alternatives

The local distribution networks of the telephone companies, composed primarily of twisted copper pairs, has been largely immune to competition until recently. New developments in technology, policy/regulatory changes, market forces and possible pricing changes have or will change this situation.

A recent report by the National Telecommunications and Information Administration (NTIA) in the U.S. outlines many of

the alternative local distribution technologies.[13] Technologies available for local distribution fall into two categories: radio-based or guided. Examples of radio-based systems include digital termination systems, satellite, microwave and cellular radio. Guided communications systems include fibre optics, coaxial cable and twisted copper pairs. Guided systems require the use of rights-of-way which may be difficult to obtain for new entrants and expensive to build and operate in large metropolitan areas. In contrast, radio-based systems are not similarly constrained but require use of electromagnetic spectrum which in Canada has generally been regulated to conserve spectrum and limit the impact on telephone companies' local distribution systems.

Microwave radio systems can be attractive because of their relatively low costs. They do, however, require unobstructed line-of-sight transmission paths which may be somewhat difficult to obtain in large cities. Private microwave systems have been popular in the U.S. with high volume users since the FCC's Above 890 Mc decision which allocated certain frequencies for private use by non-common carriers. Potential liberalization of local microwave licensing in Canada could similarly result in increased usage.

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[13] Competition in the Local Exchange Telephone Service Market, NTIA Report 87-210, U.S. Department of Commerce, February 1987.

Fibre optics systems can be attractive for high traffic volumes where rights-of-way are available. The cost characteristics of fibre discussed earlier should result in greater use of this technology for local distribution.

Cable television systems have the advantage of an in-place distribution system. To be used for two-way voice and data systems, cable systems would, however, require re-design and additional equipment.

Cellular radio systems are growing rapidly, particularly in major urban markets. The NTIA report indicates that cellular, as currently designed, may not be as appropriate for providing either non-mobile or non-switched services as other alternatives. In particular, current service costs are high compared to other alternatives.

The regulatory/policy environment will play a large role in the extent to which alternative technologies impact local networks. Canada has already permitted competition in cellular radio, although it can be argued that this applies to a specialized, previously untapped, market for mobile services and does not significantly impact established local networks. Liberalization of local microwave licensing, as previously noted, will influence the use of microwave alternatives. The CRTC has already

permitted the interconnection of local private networks to the public switched telephone network of the federally regulated telephone companies, hence increasing the attractiveness of local private microwave networks to users of liberalization of licensing occurs.

The pricing policies adopted by regulators will also influence the extent of use of alternative technologies. Current CRTC pricing policies are such that both local and toll services contribute to the costs of loop and residual, referred to generally as access.[14] Any movement to cost-based pricing will increase the price of access and thereby increase the threat of local bypass. In a competitive MTS/WATS environment there may also be an incentive to bypass local networks entirely by private facilities that interconnect directly to competitors' points of presence.

Market pressures may play a more significant role in the use of local network alternatives. The current local network has been built primarily for voice communications. More users are demanding high quality, high speed, error-free data communications. While the telephone companies are installing digital facilities, opportunities may arise for competitive

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[14] Competition in Public Long Distance Telephone Service, Federal-Provincial-Territorial Task Force on Telecommunications, December 1988, p.165.

suppliers. Additionally, the need for large business users to manage and control their own networks, discussed earlier, extends to the local network level as well.

The overall impact of this factor is estimated to be low given that most customers prefer the ubiquity associated with the public network. The installation of alternative local distribution systems would dampen growth of the telephone companies' public system. However, telephone companies themselves are likely to be the largest users of alternative technologies, especially fibre optics, as market demands, costs and pricing policies dictate. Conversely, privately-owned systems will show some growth, particularly in a more liberalized environment.

Factor S4 - Free Trade

Free trade with the U.S. will permit U.S. companies to compete in Canada for the provision of enhanced services and the sale of telecommunications equipment. Some interviewees felt that the latter would result in cheaper network components and customer premises equipment being available in Canada. Reduced prices of customer premises equipment could, in particular, stimulate the use of public networks. Reduced prices of network components could stimulate the use of private networks with some consequent negative impact on public networks.

3.3 Impact of Policy/Regulatory Influencing Factors

This sub-section presents an analysis of a number of policy matters which could have an impact on the future use of public, private and shared networks. The various policy matters are assessed from the point of view of being implemented in 1989. However, it should be realized that many of the changes postulated would take a number of years to be implemented and/or their effects felt. Hence, most of these policy changes would have negligible effects in 1990 but would have measurable effects by 1995.

Factor E1 - Liberalized Microwave Licensing

The effect of liberalized microwave licensing was studied since the federal government is currently examining the possible liberalization of local microwave licensing. The general opinion of interviewees was that liberalizing local microwave licensing would have only a small negative effect on public network services because of the availability of other alternative distribution technologies, particularly fibre optics. As indicated earlier, liberalized local microwave licensing could stimulate the growth of privately-owned local networks with a consequent negative impact on the use of carrier-provided local private network facilities.

The situation would be similar if intercity microwave licensing were to be liberalized. Only a low impact on the use of public networks would occur because of the large start-up costs associated with building intercity microwave networks. Currently, no provision exists for the interconnection of non-carrier-provided intercity networks (microwave based or otherwise) to carrier-provided local facilities. The impact would be larger if such interconnection were permitted and if excess capacity could then be resold. Stimulation in the construction of user-owned private networks would occur, with negative impacts on carrier-provided private networks as above.

Factor E2 - MTS/WATS Competition

This policy option examines the impacts on network use from MTS/WATS competition. The key driving factor relative to network use is assumed to be MTS/WATS price reductions, which would stimulate MTS/WATS usage. While stimulation of demand would occur with price reductions, the magnitude of this stimulation and the revenue impacts are uncertain. The price elasticity of demand for MTS/WATS services is generally thought to be less in absolute value than one, hence traffic volumes would be stimulated but net revenues would be smaller. In selected market/service segments, however, the absolute value of the price elasticity of demand may be greater than one and thus net revenues in these segments could increase. Other factors such as the availability of pricing options and increased advertising may

also stimulate the demand for MTS/WATS. We estimate that MTS/WATS stimulation would be greatest with open entry.

The impact on private network use would depend on the MTS/WATS versus private line price relationship. If this price relationship is narrowed, private network use should decrease. If, on the other hand, private line rates also decrease, as is the case in the U.S. for T-1 facilities, then private network growth should also occur. Since competition should stimulate the installation of new transmission capacity, we anticipate that private line rates would also drop. Therefore, while stimulation of private network use would occur there would not be a significant cross impact between public and private networks.

Factor E3 - Local Service Competition

A number of interviewees expressed the opinion that pressure will mount to allow competition in local services before the end of the coming decade. Currently only limited competition in the form of resale to provide local services except pay telephone service exists within the territories of the federally regulated telephone companies. One U.S. writer provides a rationale for why such competition might occur.[15] This writer feels that the current subscriber loop in the U.S. is a severe bottleneck that

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[15] A Fibre Optics Broadband ISDN Network? It's up to Congress, Jim Rice, Telephony, Volume 216, No. 8, February 20, 1989, p.30.

is choking the flow of information between increasingly sophisticated providers and consumers of information. Competition and de-regulation in the U.S. interexchange industry was extremely effective for deploying fibre optic technology in the intercity market. Concurrently, personal computers emerged creating a requirement for bandwidth intensive communications services. Fibre and decreasing prices essentially eliminated any bottlenecks in the intercity market. The writer likens the current U.S. intercity network to communications superhighways without any exit ramps. He argues that allowing competition in the provision of local distribution facilities is the best way to eliminate the local bottleneck. This, he indicates, would accomplish the transition to a fibre optic-based broadband network quickly at the lowest cost to the consumer.

Hence, it can be argued that if liberalized approaches to the provision of intercity facilities and services were to be adopted in Canada (for example, MTS/WATS competition, liberalized microwave licensing), considerable stimulation of intercity telecommunications usage would occur. In addition, competing carriers who depend on the local distribution system of the telephone companies may seek alternative local access arrangements to avoid use of the facilities of those they compete with. Both of these factors could bring pressure to bear to liberalize local service provision (i.e., to allow open

competition in the provision of local telephone systems and services).

Factor E4 - Liberalized Sharing and Resale

Sharing and resale of the facilities and services of the federally regulated carriers to provide non-MTS/WATS services is currently permitted by the CRTC. Resale to provide private line services based on arbitrage is limited because of the relatively small resale margins available from the purchase of bulk facilities and rules requiring the resale of dedicated circuits. Resale not based on arbitrage, for example, Cancom's resale of satellite facilities to provide VSAT services, is not similarly restricted, however, the Canadian market is not large. Sharing, as defined by the CRTC, is limited, according to a number of interviewees, by the rules governing sharing groups (i.e. the liability rules) and by the fact that, after administrative costs are deducted, savings are not substantial.

This policy option examines the impacts on public, private and shared networks of liberalizing of sharing and resale in three key areas:

E4.1 Resale of Private Line Services

E4.2 Resale and Sharing to provide MTS/WATS

E4.3 Resale of User Owned Networks

With respect to the resale of private line services, we postulate removal of the requirement to resell private line facilities to provide dedicated private line circuits. Such liberalization would improve the financial margins for resellers and would likely increase the use of private line facilities by business customers.

Resale and sharing to provide MTS/WATS would have greater market appeal and could have a greater impact on public, private and shared network use. In a liberalized environment, we would postulate the removal of current sharing rules which limit their use. The predominant form of resale would likely be resale of WATS to provide MTS. We estimate that the overall impact on the use of the public network would be positive from the stimulation occurring in the use of WATS. Some stimulation in the use of carrier-provided private line facilities for resale and shared use would also occur as resellers and sharers place some of their traffic on private line facilities.

Current policy prohibits the interconnection of intercity private network to the public switched telephone network and the resale of excess capacity. If these restrictions were to be removed, growth in private networks would be stimulated with consequent negative impacts on public network services. User-owned network growth might be stimulated more than carrier-provided private

networks i.e., there would also be a small negative cross-impact on carrier-provided private networks.

Factor E5 - Uniform National Telecommunications Policy

This factor is discussed in Chapter 4.0 dealing with cross-impacts.

4.0 CROSS-IMPACT ANALYSIS

The purpose of this chapter is to provide a summary of the cross-impacts between public, private and shared telecommunications networks as a result of the various factors discussed in the previous chapter. Specifically, this chapter examines those factors which cause users to migrate from one network type to another, i.e., the use of one network type will have a cross-impact on other network types. We have omitted from this discussion those factors which have only a direct impact on a network type and do not cause user migration. The chapter presents from our analysis the direction of the impact, the relative magnitude of revenue shifts (high, medium and low) and the key factors causing users to migrate to or choose a particular network alternative. It should be noted that high, medium and low indicate the relative importance of the revenue shift. These relative shifts should be considered in terms of the relative magnitude of public, private and shared revenues. In this respect, the dominance of public network revenues mask even large shifts to private and shared, i.e., relative to these categories.

The analysis is divided into two sub-sections: cross-impacts from supply and demand factors; and, cross-impacts from policy/regulatory change.

4.1 Cross-Impacts from Supply and Demand Factors

Exhibit 4-1 presents a summary of the cross-impacts resulting from the supply and demand factors considered previously. Factors are listed in descending order of priority as assessed in our interviews and workshops.

Pricing

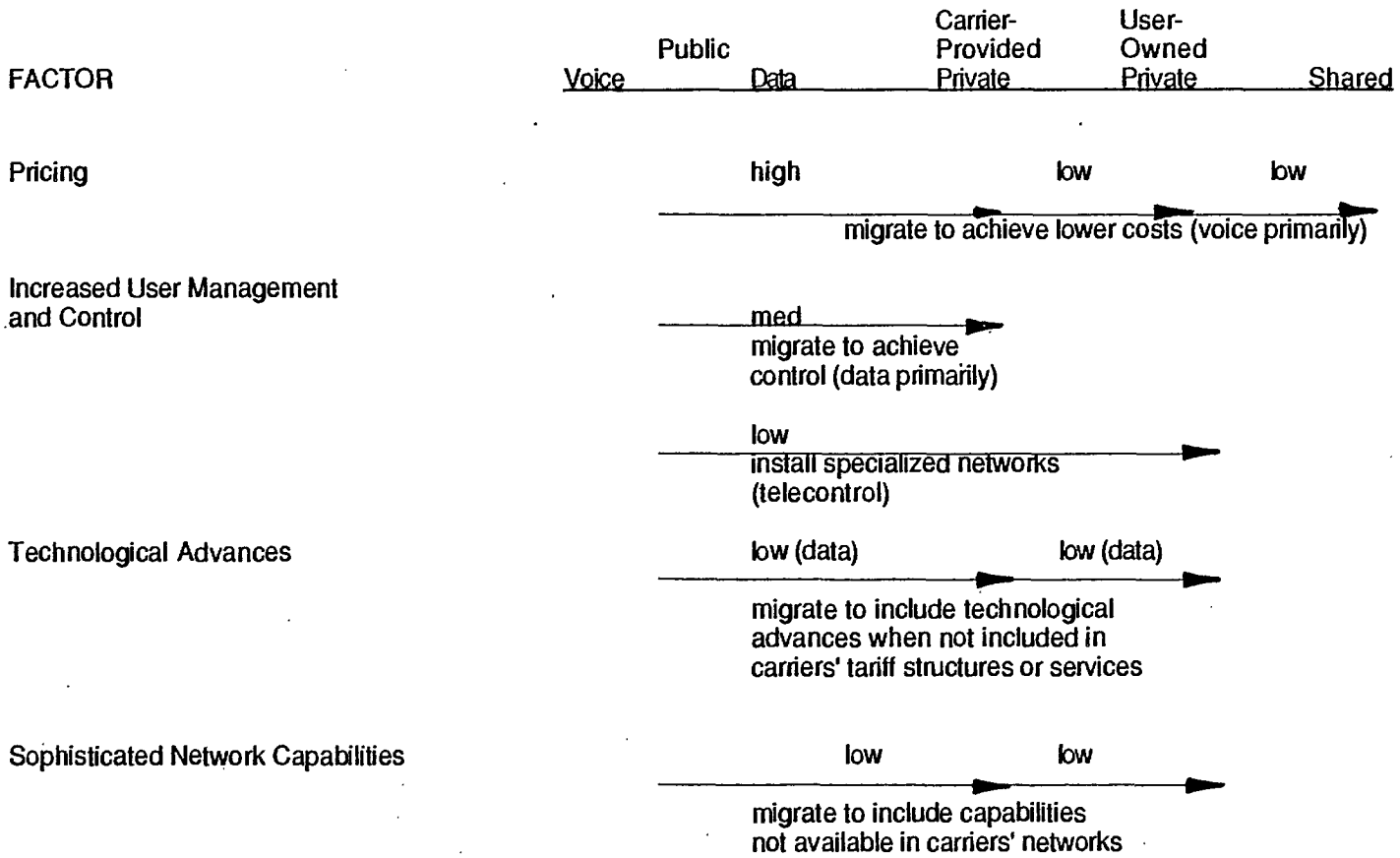
Current MTS/WATS pricing levels were considered by most interviewees as the key factor which causes users to migrate from public network services to alternatives. Specifically, large users will employ private networks where voice traffic volumes warrant to take advantage of the pricing of carrier-provided private line facilities, user-owned facilities, or shared facilities. The relative revenue shifts are highest for public voice to carrier-provided and lower for other categories.

Increased User Management and Control

The desire of users for increased user management and control causes users to migrate to either carrier-provided networks or user-owned networks. This factor was, in fact, considered the major reasons why users choose private network for data traffic; either to explicitly control network parameters in data applications or to install specialized networks not available from carriers. While this factor is key for data traffic, its overall impact on cross-impact revenues is rated

Exhibit 4-1

CROSS-IMPACT ANALYSIS - SUPPLY/DEMAND FACTORS



medium to low because of the relatively smaller magnitude of data revenues compared to voice.

Technological Advances

Users will migrate to carrier-provided or user-owned private networks to include technological advances which have not been included in the carriers' tariffs or services. We consider that this is only significant in the case of data communications and would not be sufficient to induce users to shift voice traffic. The relative effect on cross-impact revenue shifts is considered to be low.

Sophisticated Network Capabilities

Finally, users will migrate to or justify the use of carrier-provided and user-owned networks on the basis of taking advantage of new network capabilities not available in carriers' networks. These include features such as common channel signalling and software defined networks. Given that only the very largest users could afford to develop such capabilities, the relative impacts of revenue shifts would be low. These same capabilities, of course, installed in carriers' networks could cause users to migrate from private networks to public networks.

4.2 Cross-Impacts from Regulatory/Policy Changes

Exhibit 4-2 presents a summary of the cross-impacts resulting from regulatory/policy changes which could be adopted by government. Areas of policy change are listed in descending order of importance relative to their impact on cross-impact revenue shifts.

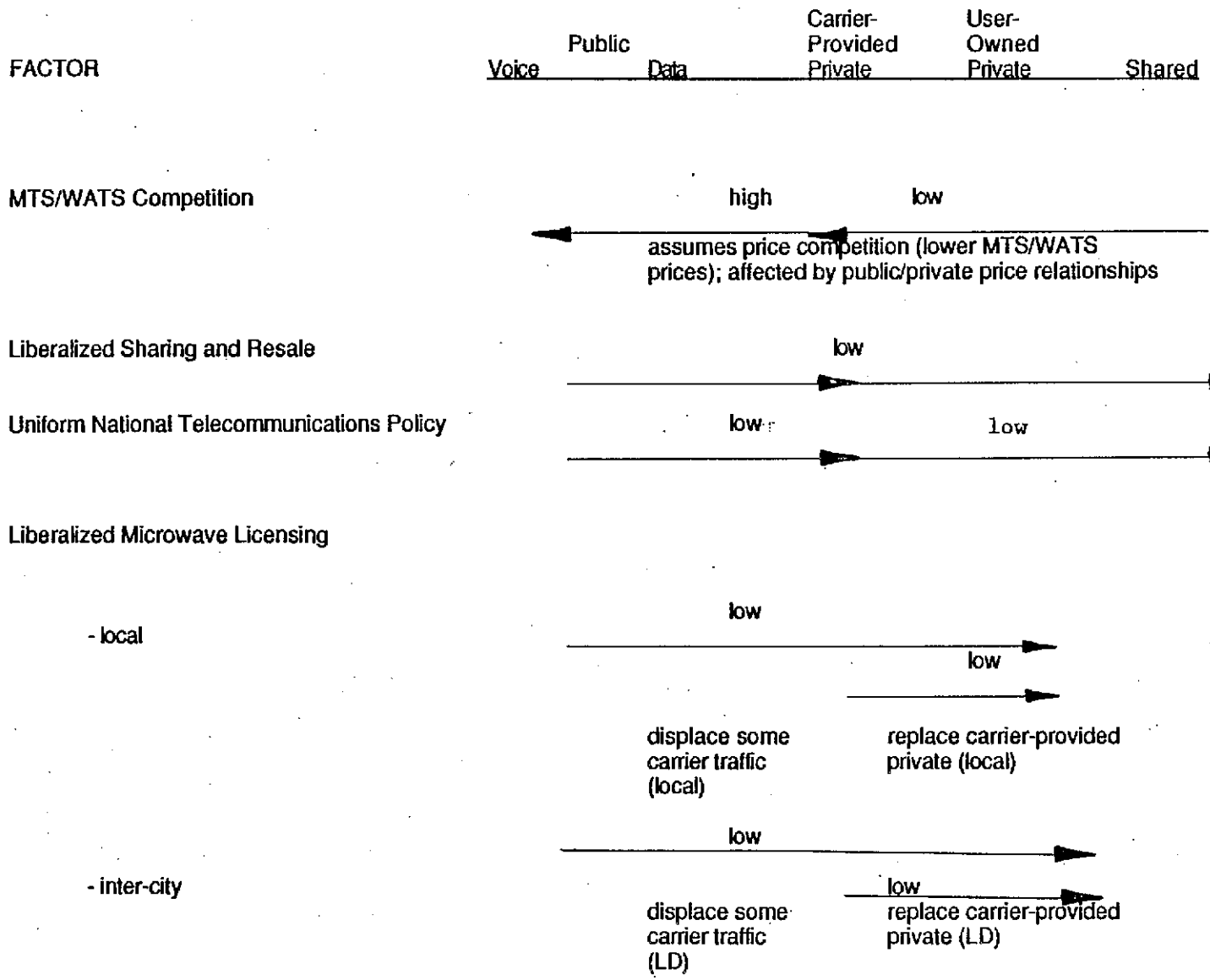
MTS/WATS Competition

MTS/WATS competition will have a large effect, over the long term, in causing users to migrate from carrier-provided and shared systems to the public network. We assume that MTS/WATS competition would induce MTS/WATS price reductions and/or rate rebalancing, leading eventually to cost-based pricing. In general, the public network, representing the ultimate in shared networks, should be able to provide the lowest cost services.

The migration from private to public will be affected by the public/private price relationship. We would anticipate from the U.S. experience that the MTS/WATS versus analog IXVG rate gap will be narrowed, leading to a relative reduction in analog private line facilities. However, T-1 private line rates will likely decline in concert with MTS/WATS rates such that an incentive will remain to use T-1 private lines. Eventually, however, T-1 and higher speed switched digital services will be provided on the public network and should partially offset the use of T-1 private line facilities and services.

Exhibit 4-2

CROSS-IMPACT ANALYSIS - REGULATORY/POLICY FACTORS



Liberalized Sharing and Resale

Liberalization of the rules on sharing and resale would have some small cross-impacts. Some stimulation in the use of the public network would occur through the migration of users to lower priced WATS (resale of WATS to provide MTS). Additionally, some increase in the use of carrier-provided private line facilities would occur as resellers and shared placed some of their traffic on private line facilities. Liberalization of the rules regarding resale and shared use of user-owned networks would also have negative cross-impacts on public network services and carrier-provided private networks.

Uniform National Telecommunications Policy

The development of a uniform national telecommunications policy would generate only small cross-impact effects. It is assumed that a national policy would result in the same rules relating to issues such as interconnection, MTS/WATS competition, sharing and resale, etc. being applied uniformly across the country. Since a consistent set of rules currently applies to the federally regulated carriers, representing over 70 percent of the market and considering that policies regarding the provision of private line facilities on a transCanada basis are the same for all Telecom Canada members, additional cross-impacts would be small. Some additional private and shared networks would undoubtedly be provided by competitors such as CNCP, however, the

likely additional private line revenues they would generate would have only minor impacts when compared to total revenues.

Liberalized Microwave Licensing

As indicated earlier, the impact of liberalizing local and intercity microwave licensing is estimated to be low, particularly because of the availability of other technologies. The liberalization of local and intercity microwave licensing could cause the migration of public network traffic to user-owned systems as well as the migration from carrier-provided systems to user-owned systems. Combined with more liberalized rules regarding sharing and resale, increased sharing and resale activity may also occur.

4.3 Revenue Impacts of Cross-Impact Analysis

Exhibit 4-3 presents general estimates of total telecommunications network revenues for Canada (1980 to 2000). Revenues are shown graphically in Exhibit 4-4. These revenues include the total of all services provided by the telecommunications carriers, resellers, shared facilities as well as the estimated value of the services provided on user-owned facilities. The figures, presented in current dollars, are based on the averaged collective results of the study which include the following assumptions and conclusions:

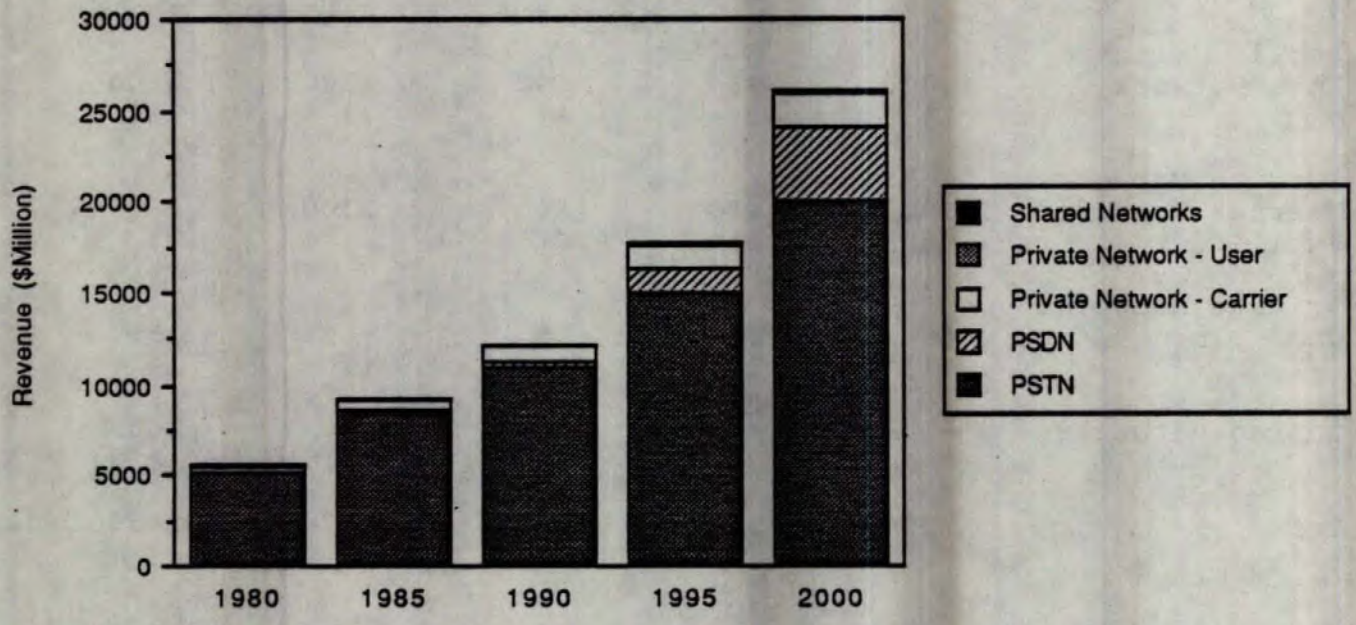
Exhibit 4-3

Estimated Telecommunications Network Revenues and Percentage of Total Market Revenues ($ millions)

	1980	1985	1990	1995	2000
Public Switched Telephone Network	5200 93%	8600 93%	11000 90%	15000 85%	20000 76%
Public Switched Data Network	50 1%	90 1%	300 2%	1300 7%	4100 16%
Private Network Carrier Provided Facilities	300 5%	470 5%	800 7%	1300 7%	1800 7%
Private Networks User Owned	40 1%	50 1%	65 1%	100 1%	150 1%
Shared Networks	-	-	10 (<1%)	40 (<1%)	100 (<1%)
Total	5590	9210	12175	17740	26150

Source: NGL Consulting Ltd.

Exhibit 4-4: Estimated Telecommunications Network Revenues



Source: NGL Consulting

- PSTN revenues will continue to grow at between 6 and 7 percent annually stimulated by general economic conditions, continued growth in use of terminal equipment, growth in enhanced voice services, as well as continued rate rebalancing and the introduction of MTS/WATS competition.

- Public switched data revenues will continue their current trend of 30 to 35 percent growth led by strong growth in demand for packet switched data services, as well as high growth in public E-mail, intelligent network services and ISDN. The introduction of virtual network services in the mid 1990s will further stimulate demand for public data networks, and in turn reduce the growth in demand for carrier-provided private lines particularly to medium sized businesses.

- Private networks based on carrier-provided facilities will grow at approximately 10 percent annually assuming that there are price reductions in intercity services to maintain similar cross-over relationships with the PSTN as exist today. MTS/WATS competition will also be a key contributing factor.

- User-owned Private Networks will grow at approximately 10 percent year assuming that the rules regarding the licensing of local and intercity microwave facilities to users are relaxed within the next few years. While this growth will be high compared to historical trends, the percentage of the total market represented by these facilities will remain unchanged over the next 10 years.

- Shared networks at the present time make up a negligible portion of the total demand for private networks. Assuming that the rules are relaxed in the near future, there will be some growth in the category which will in turn contribute to the overall growth in carrier-provided private line facilities. However, provision of virtual network services will offset the demand for shared networks assuming that prices are competitive.

- Inflation assumed to continue at present trend.

While the figures are only broad estimates, they illustrate the effect of the continuing trend of high growth in public switched services relative to other services particularly during the 1995-

2000 time frame. Public switched data services, for example, could grow from 2 percent to 16 percent of the total market. PSTN services will continue to grow steadily, however, their overall percentage of the total market will be reduced primarily because of strong growth in the data area.

The exhibit also illustrates that factoring in the policy changes regarding private networks will not significantly change the percentage of the total market represented by these services. Private and shared networks will continue to represent less than 10 percent of the market up to the year 2000.

5.0 SUMMARY, CONCLUSIONS AND EVALUATION OF THE METHODOLOGY

This chapter presents a summary of the main findings of the study, particularly on the issue of the cross-impacts of private and shared networks versus public networks. In addition, this chapter presents an assessment of the cross-impact methodology used in the study.

5.1 Summary and Conclusions on the Use of Public, Private and Shared Telecommunications Networks

This report has presented a methodology and framework for assessing the cross-impacts of public, private and shared network and a ranking of the cross-impact factors having the greatest impact on public, private and shared networks to the year 2000.

Data for five categories of network/services were collected for the cross-impact analysis as follows:

1) Public-Switched Telephone Network
2) Public-Switched Data Networks/Services
3) Private Networks - Carrier-Provided Facilities
4) Private Networks - User-Owned Facilities
5) Private Networks - Shared

This particular categorization of networks/services was chosen, in part, on the basis of publicly available data. Whereas useful

data could be obtained for these categories, further disaggregation was not possible due to a lack of publicly available data, particularly for private networks/services. The study would have, in fact, benefitted from a more detailed understanding of the components of these categories.

The following factors were determined from interviews and a workshop to influence the supply and demand for public, private and shared networks:

Demand-Influencing Factors

1) Pricing - current long distance rates are perceived to be high and cause some business users to choose private and shared networks rather than public network services.

2) Growth in information technologies has stimulated demand, particularly in data communications.

3) Increased user management and control of telecommunications facilities is being undertaken by business users to achieve maximum benefit from telecommunications and information technologies.

4) Economic factors influence users requirements for telecommunications services/networks.

Supply-Influencing Factors

1) Technological advances have and will allow for lower costs and greater capabilities.

2) Increasingly sophisticated public and private network capabilities will permit a wide range of new services to be provided to users.

3) A wide array of local access technologies is available to provide alternatives to traditional local distribution technologies.

4) Free trade will increase enhanced service and telecommunications equipment supply options.

In addition, a number of policy/regulatory factors were examined which could influence supply and demand. These include:

1) Liberalizing microwave licensing which could increase supply options for local and intercity networks.

2) MTS/WATS competition which would allow other suppliers into the long distance market.

3) Local service competition which might occur subsequent to MTS/WATS competition.

4) Liberalized sharing and resale to allow resale of private lines, provision of MTS/WATS and resale of user owned networks.

5) A uniform national telecommunications policy which would lead to consistent supply options across the country.

Only a limited number of the above factors create noticeable cross-impacts; that is, effects which cause migration amongst public, private and shared networks. The current high levels of MTS/WATS prices were considered by most interviewees and workshop participants as the key factor which causes users to migrate from public network services to alternatives, particularly for voice communications. The desire for increased user management and control causes migration to private networks. This was perceived to be a key factor for data communications. Technological advances cause migration to private networks if these advances are not reflected in carriers' networks, particularly in the

tariff structure. New network capabilities, such as software defined networks, may reverse the trend to private networks and encourage users to migrate to or remain on public networks.

We conclude that MTS/WATS competition, if it were to lead to cost-based pricing, would reduce the migration to private networks. However, an incentive to use digital private line networks will likely remain since digital private line rates should decrease in concert with MTS/WATS rates. Liberalized sharing and resale would have some small cross-impacts as users migrate to lower priced alternatives based on WATS and/or private line/network facilities. A uniform national telecommunications policy, while it would lead to uniform supply options, would have only small cross-impact effects since consistent rules already apply to federally regulated carriers and private line facilities are available through Telecom Canada members. Liberalized microwave licensing would also have only small cross-impact effects, particularly because of the availability of other technologies.

All indicators point to continued substantial growth in all telecommunications networks and services. Continued growth in public voice telephone services is anticipated to the year 2000 and beyond. Furthermore, a high growth rate can be expected in public network data services. From the above discussion, we estimate on the whole that only small, cross-impact effects will

be generated by various economic, regulatory and policy factors relating to the use of public, private and shared telecommunications networks by business. It, in fact, would be extremely difficult to substantiate harm in the provision of public network services from cross-impacts when all network/service categories are growing and when public network services completely dominate other categories. Even large changes in private and shared network use would have relatively little effect.

Our interviews indicate that the same conclusion was reached in the U.S. with regard to bypass. With liberalization of the U.S. telecommunications environment, many people feared that bypass would threaten the universality of public telephone service. However, the incidence of bypass has not been as great as feared and its anticipated negative impacts have not surfaced in the strongly growing U.S. telecommunications market. Furthermore, the U.S. instituted targetted subsidy measures designed to assist telephone companies and individuals who might have otherwise been negatively impacted. The result is that telephone penetration has actually increased in the U.S. in recent years.

5.2 Evaluation of the Cross-Impact Methodology

This sub-section provides an assessment of the cross-impact methodology used in this study. The assessment is based on our

own analysis plus comments received from workshop attendees.

In our opinion the interviews conducted prior to the workshop proved to be an effective means of determining the key factors which impact network/service growth and cross-impacts. No one single interviewee had a complete view of the environment, however, when considered collectively the interviews and our independent literature research provided a comprehensive picture.

We consider, however, that the process is incomplete. The half-day workshop which was conducted at the completion of the interviews did not provide sufficient time for participants to become familiar with the material nor respond in a comprehensive manner. Because of time constraints, participants were not apprised of the findings of our research prior to attending the workshop. Additionally, workshop attendees suggested a number of improvements. Key among these was that discussion should be focussed around a number of key scenarios. Such scenarios could, for example, postulate the cross-impacts from a variety of technological, economic and policy factors.

We would recommend that additional work be undertaken as follows:

1) That the report be sent to interviewees and workshop participants for review and comment.

2) That they provide:
   i) overall comments (eg., 1-2 pages on the results in general);

ii) detailed comments written onto a copy of the report.

3) That the report be modified to include the detailed comments and that the general comments be provided as an Appendix.

4) (Optional) that steps 1, 2 and 3 be repeated depending on the extent of modification required.

We feel that the process to date has been worthwhile and resulted in valuable insights into the use of public, private and shared networks. The collective advice of experts, gathered as outlined above, would significantly enhance the final product.

Appendix A

Statement of Work

Statement of Work
Public, Private and Shared Telecommunications Networks
A Cross-Impact Study to the Year 2000

Introduction

The telecommunications industry in every country has entered a new phase where changing technological, economic and political factors are creating a proliferation of alternative facilities and services for carriers and their customers. Previously separate technologies and markets are merging to create new integrated services combinations and new markets. Carriers are introducing ISDN technology to take advantage of the opportunities at hand. The large scale introduction of optical fibers is resulting in a substantial drop in transmission costs. Deregulation of the telecommunication industry is continuing apace and in the next decade, competition may take place in toll telephone services. Rates and costs for individual public services may also be brought into line in the future. New cost-based rate making principles may also be introduced into public telecommunication services. Developments in local distribution facilities, satellites and software-defined networks are also profoundly changing the economics of supply. Large business users, in particular, are facing an increasing range of choice in how best to satisfy their expanding needs for telecommunications facilities and services.

One of the consequences of these factors is a significant increase in the demand by business for private and shared networks as an alternative to public networks. There is no doubt that Canadian businesses need the most cost-effective telecommunication facilities and services in competing in the national and international marketplace and it is important to public policy that their needs are being satisfied. Even in the absence of hard economic reasons, some companies are finding that privately-owned or shared networks offer greater advantages. On the other hand, inherent biases in regulatory policies may favor use of private or shared networks over public networks to the detriment of the public telephone network and other public services. Carried to the extreme, this could jeopardize the universal nature of public telephone services. It is important for these reasons to develop a broad methodological framework for analyzing the cross-impacts of privately-owned or shared networks versus public networks that is capable of assessing the public policy issues in telecommunications over the next ten years.

Identification of Factors In Need of Consideration in the Development of a Framework and Analysis

Clearly, the future of public and private telecommunications facilities and services will be influence by developments in technology, economics, and regulation as well as the strategies of the various players in the industry and their users. The most important of these will need to be identified and assessed in the study.

Developments in local microwave technology, satellite technology, optical fibers as well as software defined networks, open network architecture and ISDN will affect both private, shared and

APPENDIX "A"

public networks. On the other hand, users will be motivated by technology and economic factors to either rely increasingly in the public telephone network, on leased facilities or on completely privately-owned or shared facilities. Other factors such as quality, reliability, and the need to control telecommunications facilities will also influence their purchasing decisions. Those users which choose to manage their own telecommunications facilities and networks will also incurr the costs of operating them. Some users will prefer to build substantial intelligence into their own networks while other will prefer to rely on the intelligence built into the carrier networks. Carriers are responding to the challenges and opportunities by deploying ISDN technology in all of their new service offerings.

At the same time, regulatory policy developments will also influence the trade-off between public, private and shared networks over the next decade. These include the distinctions between Type I and Type II carriers and the regulations affecting the relative freedom of entry into each, the introduction of competition in message toll services, rate rebalancing and the introduction of various kinds of access changes into the pricing of public telecommunications services. Other possible regulatory changes include the introduction of cost-based rates in public telecommunications and the liberalizing of local microwave licencing regulations.

The outcome of the analysis will be a methodology and framework for assessing the cross-impacts of private, shared and public networks over the next decade together with a qualitative assessment of the interaction of the various forces and factors over this time period. It is, of course, important to identify, analyze and rank those developments that are expected to have the greatest impact on the development of both private, shared and public networks in Canada to the year 2000.

Work to be Done

The work to be done is described as follows:

1. To investigate and analyze the technological, economic and regulatory factors affecting the demand by business for private, shared and public network facilities and services to the year 2000.

2. To identify and extrapolate the technological, economic, regulatory and other trends influencing the supply of public, shared and private networks up to the year 2000.

3. To undertake a cross-impact analysis of the use of public, private and shared telecommunication networks by businesses up to the year 2000, under various pricing, technological, regulatory and other scenarios.

4. To analyze and identify those regulatory and other policies which affect this tradeoff in the use of public, private and shared networks and derive qualitative and quantitative estimates of the impacts in the year 2000.

Appendix B

Futures Methods

Roy Amara, President

Institute for the Future

FUTURES METHODS

Roy Amara, President
Institute for the Future

There is perhaps no subject on which futurists disagree more than whether the field or activity has any common base of methodological tools from which it draws and what the applicability and value of such tools and approaches may be. Indeed, the commentary on strengths, weaknesses, and gaps (Chapter IV) specifically notes that futurists have little common ground, are very thin in the use of quantitative techniques, and are not normally explicit about their assumptions. In the following, I would like to do some "gap filling" by providing a brief overview of the current state and likely future direction of the methodological side of futures research.

THE INVISIBLE INFRASTRUCTURE

In the last decade, perhaps the most important trend in the use of planning tools has been the move away from methodological formalisms and doctrinaire approaches—particularly those that purport to reduce planning to a mechanistic sequence of steps or "silver bullet" solutions. The following is a summary of the evolution of the methods we have used and some lessons we have learned.

Expert Judgment

The elicitation and use of expert judgment have remained—and will very likely remain—a mainstay of our work. This is because we are generally working with situations where the tools of the econometric modeler or the statistical forecaster are not as applicable—historical data are unavailable or inadequate and/or time horizons are too long. Seldom, however, do we now use Delphi as developed and applied in the 1960s and 1970s. It has proved too slow (for example, mailing questionnaires), too expensive, and, most important, too blunt an instrument for most applications.

For group processes, our generally preferred vehicle is the structured workshop at which expert judgments may be elicited and aggregated in an interactive environment. Almost always, such workshops are preceded by one-on-one interviews with experts (usually, but not always, different from those used in the workshop) to set the stage for the workshops. Where appropriate, eliciting judgments may include information to construct a full probability distribution of a key variable—such as oil prices. In other instances, such as in forecasting possible political or regulatory developments, judgments do not have quantitative boundaries.

At the same time, we have become far more eclectic in using tools for eliciting judgments or opinions. This is particularly true when a need exists for developing information about current or short-term perceptions and attitudes about existing or evolving products, services, or processes. In some instances, we have used focus groups. In others, we have relied on the results of customized surveys of targeted groups. Indeed, some of the most exciting methodological developments in forecasting may increasingly emerge from the marriage of tools that have previously been used separately.

Structural Modeling

Usually, we are as interested in the perceived connections or interrelationships among developments, trends, events, and factors as we are in the outcome or forecast that they may produce. This is why spreadsheet-like tools such as cross-impact analysis have always been high on the futures planner's list. It represents one of a family of matrix methods for representing and for checking the consistency of logical connections between all possible factor-pairs.

Over the years, we have refined and extended cross-impact analysis through a computer-assisted process called Dynamic Cross Impact Modeling (DYCIM). But we also have found that its use is quite limited—primarily to situations in which the focus is on sharply defined, and often technical, variables such as global world temperature, or the tensile strength of a composite material, or the conversion efficiency of photovoltaics. It has not proved an effective tool in very complex environments where basic structural changes are occurring—health care after cost containment, for example, or the communications industry after divestiture.

In such situations, our preferred modeling tools often are "softer," opting for qualitative descriptions of interactions or clusters of interacting variables. These may be represented by simple logical block diagrams that focus only on key factors. In other instances, we have been able to isolate a market or a set of developments to construct simple forecasting models using spreadsheet methods available on personal computers. Computer models have been delivered to clients on diskettes.

Descriptive Forecasting

The clearest winner in the methodological sweepstakes has been the scenario. We now use scenarios more frequently than in the past and in a greater variety of situations—both as end products and as "front ends" for issue generation or for evaluating options.

A scenario is nothing more than a description of an internally consistent, plausible future. Therein lies one of its major strengths—it does not purport to be a prediction. It is a construct that can be used in a variety of ways by a variety of participants in planning. Flexibility is its other major asset. Scenarios are for Everyperson: long or short; quantitative, qualitative, or in between; macro or micro in scope.

Why has it become the method of choice for many planners? First, because of the bankruptcy of deterministic forecasting. Second, scenarios are in keeping with the trend toward less formalism. Third, they provide an opportunity to involve decision makers in a participatory way—to "buy into" a process. And, last but not least, their use has been legitimated by some widely read articles in the business press.

SETTING NEW DIRECTIONS

To make any credible attempt to identify new methodological directions in futures planning (FP), it is important to see FP in the context of other related activities that have preceded it. In the period from the 1930s or early 1940s to the late 1960s or early 1970s, a veritable explosion occurred in analytical activities aimed at helping us to forecast, plan, solve problems, and make decisions. These are summarized in tabular form in Table 1. FP is one of the last in this sequence. Although each activity or field has distinctive

features, a common thread linking them is that they all deal with large, changing, complex physical or social systems. Another common feature is that each activity has a "back-bone" analytical orientation based on its dominant discipline (see Table 1) that expresses itself as an attempt to model or represent complex systems. But this is where the similarity ends. FP has a number of distinctive features that set it apart from its sister activities. The first of these differences is FP's long-range forecasting component. The second distinctive feature of FP is its focus on generating or creating images or visions. The third dimension that distinguishes FP from its sister activities is its participative component.

Table 1

Possible Components of a Science of Complexity and Change

Field	Dominant Discipline	Description
Systems Engineering	Engineering	Design of large, complex physical systems (telephone, weapon systems) focusing on system structure (requirements/alternatives/evaluation cycles) and system control
Operations Research	Physics	Analysis of operational problems involving people and machines and focusing primarily on short-term (tactical) aspects
Systems Analysis	Economics	Analysis and synthesis of large systems using cost/benefit, cost/effectiveness, and planning/ programming/budgetary methodologies and focusing on tactical and strategic consequences of choices
Decision Analysis	Management/ Business	Analysis of both short-term and long-term decision-making processes using probabilistic, time, and risk preference concepts
Policy Analysis	Political Science	Analysis of resource, financial/budgetary, and political factors with emphasis on policymaking processes in the public sector
Futures Planning	Social Science	Analysis of long-term alternative futures with emphasis on judgmental, social, and participative elements

Source: IFTF

How can the tools of futures planning be sharpened further? What advances would provide the greatest value added for practitioners and consumers of FP? In what area are advances most likely to be made in the next decade?

As in other fields, advances in FP are the result of both methodology "push" and user "pull." Our best guess for methodological advances in FP are:

- Setting agendas
- Detecting and describing structural change
- Interleaving planning and acting.

Setting Agendas

In a more formal methodological sense, the work of FP falls under the scientific rubric of "problem solving and decision making."* Problem solving is about selecting agendas: identifying key variables for modeling, choosing issues, setting goals or objectives, generating options or choices. Decision making is about evaluating given agendas, variables, goals, options, and choosing among them in accordance with some selected criteria.

Futures planning includes in its scope both sets of activities, although we believe that its more distinctive contributions have been and will be made in problem solving. In part, this is because some of its sister activities—notably, decision analysis and policy analysis have focused on the centerpiece of decision making: the theory of subjective expected utility, the limits of rationality, and choice under uncertainty. In part, it is because FP essentially is about searching through large sets of possibilities to select what is most relevant, most important, most worthy of our attention. In the vernacular, it normally comprises the "front end" of forecasting and planning processes where the wheat needs to be separated from the chaff, where possible patterns need to be detected, and where what is to be monitored must be identified.

Unfortunately, it is at this front end where problem-solving processes are least well developed and understood. For example, we know much more about prioritizing and ranking a list of environmental factors or items than we know about how to decide what

*"Scientific Futures Selected Areas of Opportunity," Washington, DC: National Academy Press, 1986.

should be included in a model of the situation to begin with. Because the possibilities in any given situation are far too numerous to do exhaustive searching, various "rules of thumb" are applied to do the initial narrowing. In FP, such problem-solving activities appear in a number of areas: in how we identify key environmental factors, in how we select experts, in how we guide the choice of organizational objectives/goals, in how we generate options that should be considered by managers and executives. This "setting of agendas" is closely related to how we frame problems—that is, how we represent or describe a situation.

It may be that the work of artificial intelligence in recent years may provide the basis for new understanding in agenda setting or problem solving, even though humans and computers generally use quite different processes: computers generally rely on large bodies of data, whereas humans use richer sets of "rules of thumb." Or it may be that the power of the computer as a computational or symbol processing device may have applicability in pattern recognition or selective search.

Structural Change

Simply put, structural change is about basic changes in the pattern or makeup of a system. For an airline system, it may be a change from point-to-point to hub-and-spoke structure. In health care, it may be the shift in health care delivery away from traditional fee-for-service toward contract or capitated systems (systems such as HMOs in which providers receive a fee per patient enrolled). In telecommunications, it is represented by changes in industry before and after divestiture.

Sometimes, structural change happens unexpectedly such as in telecommunications or health care. Often, it happens with forewarning, but the exact form it will take is not clear, as in financial services. However it occurs, it represents a sharp break with history. Old formulas and relationships no longer apply. Uncertainties—even about the short-term future—loom large.

This is where the tools of FP could have distinctive advantages. And yet, even the best of its tools are like blunt instruments. We don't have good theories about structural change, how it occurs, how it can be detected early, how it can be understood. Structural

change is synonymous with the presence of discontinuities. Can pattern recognition techniques help in detecting significant confluences of events and trends that presage discontinuities? What about the role of nonlinear dynamical systems and the new so-called chaos theory—understanding the conditions under which complex systems with an underlying structure pass from continuous, smooth change to discontinuous, more abrupt transitions? What is the role of surprises and wild cards in detecting and monitoring structural changes? Can advance computer simulation processes be usefully applied? Even small advances here can pay rich dividends.

Planning and Acting

In 1980, we wrote: "The complexity of the problems we face has led us to specializing in planning as it has elsewhere in society. As a result, the basic activities of thinking (or imaging) and doing (or implementing) have been pulled farther apart by the analytical arm of the futures field. The two basic players are image generators and implementors. But these are also the most difficult to join because of the lack of a common language and different philosophical orientations."*

The important idea here is that we may gradually be approaching the point at which the analytic arm of FP (and its sister activities) becomes more and more invisible. The result will be what has been sought: the ability to integrate planning and acting so intimately that the two become almost inseparable. No one claims that this will be easy, but the signs are unmistakable that we are moving in that direction. The key here is the computer—and, more specifically, computer simulation.

Computer simulation has been used for a long time for war gaming, flight training, and the design of complex physical systems such as telephone and weapon systems. More recently, simulation is being used for applications closer to the corporate organization—for manufacturing simulation and business planning. These are not just computational and numerical exercises resulting in long printouts of hard-to-digest data, but full-scale models that provide graphics and animated video images of the dynamics of complex structures and systems.

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*"The Futures Field," IFTF Paper P-95, Institute for the Future, Menlo Park, CA, 1980.

The complexity of most environmental scanning, forecasting, and planning systems probably does not yet permit full simulation of such systems. But the software tools are being fashioned piece by piece to allow simulation of portions of, and then more complete, systems. These include—among others—simulations of manufacturing operations, capital investment decisions, and staffing policies. This trend is nothing more than a process that started with the use of hand calculators, spreadsheets, and English command menus for constructing mathematical models: the analytical processes become less and less visible as well as more and more sophisticated, leaving humans more and more time to focus on the more creative and intellectual tasks of setting agendas, framing issues, and problem solving.

Appendix C

Interviewees and Workshop Attendees

Appendix C

Interviewees and Workshop Attendees

Tom Moorehead	Vice President & General Manager, Satellite Business Services	Cancom
G.W. Jackson (provided documents submitted to DOC)	Manager, Telecommunications Department	Ontario Hydro
Earl Gibson	General Manager, OPP Tele-communications Project	Ontario Provincial Police
Tom Egan	President	Canadian Business Telecommunications Alliance
Jim Grant	Senior Vice President	Royal Bank
Bob Trowhill	Director, Technology Plng.	Microtel
Ray Cumberworth	Director, Marketing	Microtel
Mitch Hodgkins	Supervisor, Network Services Information Systems & Services	MacMillan Bloedel
Ian Hunter	Manager, Client Services Information Systems & Services	MacMillan Bloedel
Tom Mulholland		Imperial Oil Ltd.
Alee Mielen	Manager, Commercial Mktg.	BC Rail
Peter Cartwright	Manager, Operations & Plng.	BC Rail
Lester Taylor	Professor	Department of Economics, University of Arizona

Gerry Cohen		GTE, Stamford, Conn.
Don Kridel		Southwestern Bell
Jim Schram	AVP (Private Networks)	Bell Canada
Terry Kulka	Director-Advanced Service Planning	Bell Canada
Fred Bigham		CRTC
Dave Bell		CRTC
Evan Kiverel		FCC
Robert Pepper		FCC
Alexander Belifante		FCC
Louis Feldner		FCC
William Kirsch		FCC
Fred Lee		NTIA
Phyllis E. Hartsock		NTIA
Timothy Sloan		NTIA
Al Keddy	Director, Systems Design & Management	GTA
Daniel H. Sum	Director, Development & Engineering	GTA
Don Braden	President	ACTS
Pam MacInnis	Telecommunications Manager	National Sea Products Ltd.
Pierre Lamarche	Vice-President, Governmental Matters	CNCP
Marlon Oneid	Sales Manager	CNCP
Fernand Leger		DOC
Gerald L. Pond	Vice-President, Planning	NBTel

Harry S. Mercer	Director-Business Planning & Regulatory Matters	NBTel
D.G. Gamble	NSG National Account Manager-Irving	NBTel
Karl Hansen	Credit Manager	Irving Forest Products
John E. Gormley	Manager	Commercial Communications
David Colville	Director of Communications	Government of Nova Scotia
Fred Waller		Council of Maritime Premiers
Phil Henderson	General Manager-Planning	MT&T
Steve March	Network Planning Manager	MT&T
Linda Oliver	Supervisor Regulatory Affairs (Policy)	MT&T
Renaud de Camprieu	Manager, Market Analysis Group	Telesat Canada
Christine Sloboda	Supervisor, Market Analysis Group	Telesat Canada
Gilles Leduc	Vice-President, Marketing	Teleglobe Canada
Dezso Andorka	General Manager, North America & the Caribbean	SITA
John Davies	Manager, Network Services Strategic Planning	Northern Telecom Canada Ltd.
Michel Eric	AVP Operations, Eastern Region	Cantel

Workshop Attendees

Maurice Estabrooks	DOC
Jan Vanderveen	DOC
Dora Mozes	DOC
Tom Egan	CBTA
Ken Englehart	CBTA
David McKendry	CAC
Keith Richardson	Mitel
Renaud de Camprieu	Telesat Canada
Chris Frank	Telesat Canada
Barbara Borylo	Telesat Canada
Pierre Lamarche	CNCP
Gerry Wall	CRTC
Terry Kulka	Bell Canada
Michael Norman	Bell Canada
Tom Grandy	NGL Consulting Ltd.
Lawrence Horwood	NGL Consulting Ltd.

Appendix D

Network Usage Revenue Data

Appendix D-1

Public Switched Telephone Network Revenues

	Local ($M)	Message Toll ($M)	WATS ($M)	Total ($M)
1971	831	654	28	1513
1972	921	745	35	1701
1973	1024	879	37	1950
1974	1137	1039	62	2238
1975	1304	1246	78	2628
1976	1520	1452	94	3066
1977	1739	1646	114	3499
1978	1974	1927	145	4046
1979	2188	2225	181	4594
1980	2442	2542	225	5209
1981	2870	3125	255	6250
1982	3260	3464	323	7047
1983	3419	3707	382	7508
1984				
1985	3702	4457*	460*	8619
1986	3766	4850*	500*	9116

Source: Statistics Canada Telephone Statistics Table 18

In Table 18:
Local = Sum (Lines 1 to 4 and 9)
Message Toll = Line 11 + Line 13 + Line 30
WATS = Line 14

* Estimated on the basis of 1983 percentages of the total.

Appendix D-2

Public Switched Data Service Revenues

	($M)
1984	70
1985	85
1986	105
1987	130
1988	170
1989	220
1990	285
1991	370

Source: NGL Consulting Ltd.

Appendix D-3

Private Network Revenues - Carrier-Provided Facilities

	Local Private Line ($M)	Toll Private Line ($M)	Toll Private Line (Adjusted) ($M)	Toll Private Total Line (Adjusted) ($M)
1971	17	51	51	68
1972	18	57	57	75
1973	22	65	65	87
1974	24	75	75	99
1975	29	90	90	119
1976	39	113	113	152
1977	49	129	129	178
1978	59	162	148	207
1979	69	164	150	219
1980	77	255	210	287
1981	97	262	220	317
1982	121	311	250	371
1983	130	335	275	405
1984				
1985	156	400	315	471
1986	158	435	330	488

Source: Statistics Canada Telephone Statistics Table 18
Adjusted to exclude Public Switched Data Network Revenues per Appendix C-2

In Table 18:
Local Private Line = Local Telephone Private Line (Line 5) + Other Local Private Line (line 8)

Toll Private Line = Toll Telephone Private Line (Line 15)
+ Other Toll Private Line (Line 19) (*Adjusted to exclude Public Switched Data Revenues)

Note: Excludes investment associated with customer premises equipment

Appendix E

Detailed Analysis of the Impacts of Factors Affecting the Supply and Demand of Public, Private and Shared Telecommunications Networks

This appendix presents in tabular form an analysis of the impacts of factors affecting the supply and demand of public, private and shared telecommunications networks. The analysis is divided into two network categories: public networks; and, private and shared networks. The latter were considered as one since shared is generally a subset of private; distinctions in the analysis are indicated where appropriate. The impact of each individual factor was rated as positive or negative and zero, low, medium or high. This range was used to indicate, in the estimation of the project team, the extent of growth in network/service use or the cross-impacts resulting from any given factor. Low was used to indicate no significant changes from the existing situation. High indicates the possibility of significant change.

Impacts of Factors Affecting the Supply and Demand of Public, Private and Shared Telecommunications Networks

		FUTURE IMPACT ON USE OF PUBLIC NETWORKS		
		1990	1995	2000
DEMAND INFLUENCING FACTORS				
D1	Pricing			
D1.1	Decreasing Real Unit Prices	Med →		
D1.2	Decreasing Long Distance Prices Relative to Local			
D1.3	Phase III Cost-Based Pricing of Competitive Network Services	Low →		
D1.4	Use of IXVG and 9.6 Kbps as a voice/data benchmark price			
D1.5	Higher Canadian prices than U.S. prices	Low (-ve) →		
D2	Rapid Growth in Information Technologies			
D2.1	More Distributed Processing	Med-Voice →		
D2.2	Higher Bandwidth for Larger Files and Quick Response Time (eg. above 56 Kbps)	Med-Data	High-Data	High-Data
D2.3	Pre-processing of Information (eg. including expert systems)			
D2.4	Requirement for More Mobile Telecommunications	Med-Voice Low-Data	Med	Med

FUTURE IMPACT ON USE OF PUBLIC NETWORKS

		1990	1995	2000
D3	Increased User Management and Control of Telecom Facilities			
D3.1	Increased Demand by Users for Quality/Features/Flexibility Not Provided Cost Effectively by the Telco	low (-ve) 0 →		
D3.2	Increased Emphasis on Telecommunications as a Strategic Asset Compared to User Costs in the Decision	Low →		
D3.3	Control of Telecom Costs	0 →	(low-ve)	
D4	General Economic Factors			
D4.1	Growth in Population, Employment, GDP, Housing Starts	High-Voice → Med-Data →		
D4.2	Demographics of Business Growth	Med →		Med
D4.3	Free Trade (Stimulation of Economic Activity)	Med →		

FUTURE IMPACT ON USE OF PUBLIC NETWORKS

1990 1995 2000

SUPPLY INFLUENCING FACTORS (NON-POLICY/REGULATORY)

S1 Technological Advances

S1.1	Decreasing Network Unit Costs	Depends on Price →	
S1.2	Increased Functionality Per Unit Cost		
S1.3	Increased Connectivity/Universality		
S1.4	Use of Digital Transmission and Switching		
S1.5	Increased Capacity Per Unit Cost		
S1.6	Terminals With Increased Capabilities/Lower Price	High →	
S1.7	Substantial Reductions in Computing Costs (Processing and Storage)	High-Data Low-Voice →	
S1.8	Evolution of ISDN	0	Low-High → (depending on price)

S2 Increasingly Sophisticated Public and Private Network Capabilities

S2.1	CCS #7	0	Depends on Public vs Private Price →
S2.2	Software Defined Networks		
S2.3	Value-added/Enhanced Services	Low-Data Low-Voice	Med-Data Med-Voice / High-Data

S3 Availability of Local Access Alternatives
(FOTS, Microwave, cable, etc.)

S4 Free Trade

Low(-ve) →

0

Low-Reduced
Price of CPE →
low (-ve) - Reduced
Price of Network Equipment

FUTURE IMPACT ON USE OF PUBLIC NETWORKS

			1990	1995	2000
POLICY/REGULATORY INFLUENCING FACTORS					
E1	Liberalized Microwave Licensing				
	E1.1	Local	0	0-Low(-ve)	0-Low(-ve)
	E1.2	Inter-city	0	0-Low(-ve)	0-Low(-ve)
E2	MTS/WATS Competition				
	E2.1	Limited	0	Low-Voice	Med-Voice
	E2.2	Open	0	Med-Voice	High-Voice
E3	Local Service Competition				
	E3.1 E3.2	Cable Based Radio Based	0	Low	Med
E4	Liberalized Sharing and Resale				
	E4.1	Non-MTS/WATS (P/L)	0	Low-ve	→
	E4.2	MTS/WATS	0	Low →	
	E4.3	User Owned Networks		Low(-ve)	→
E5	Uniform National Telecommunications Policy eg. Terminal Attachment, Interconnection in all Provinces		0 →	Low (-ve)	→

FUTURE IMPACT ON USE OF PRIVATE AND SHARED NETWORKS

DEMAND INFLUENCING FACTORS		1990	1995	2000
D1	Pricing			
D1.1	Decreasing Real Unit Prices		Med →	
D1.2	Decreasing Long Distance Prices Relative to Local		Low(-ve) →	
D1.3	Phase III Cost-Based Pricing of Competitive Network Services		High(-ve) →	
D1.4	Use of IXVG and 9.6 Kbps as a voice/data benchmark price			
D1.5	Higher Canadian prices than U.S. prices		Low(+ve) (for bypass) →	
D2	Rapid Growth in Information Services			
D2.1	Higher Bandwidth for Larger Files and Quick Response Time (eg. above 56 Kbps)		Med →	
D2.2	More Distributed Processing			
D2.3	Pre-processing of Information (eg. including expert systems)			
D2.4	Requirement for More Mobile Telecommunications		Low →	

FUTURE IMPACT ON USE OF PRIVATE AND SHARED NETWORKS

1990 1995 2000

D3 Increased User Management and Control of Telecom Facilities

D3.1 Increased Demand by Users for Quality/Features/Flexibility Not Provided Cost Effectively by the Telco

High (Both User Owned and Carrier Provided)

D3.2 Increased Emphasis on Telecommunications as a Strategic Asset Compared to User Cost in the Decision

High-Data →
Med-Voice

D3.3 Control for Telecom Costs

Med →

D4 General Economic Factors

D4.1 Growth in Population, Employment, GDP, Housing Starts
D4.2 Demographics of Business Growth

Med →

D4.3 Free Trade (Stimulation of Economic Activity)

Low →

FUTURE IMPACT ON USE OF PRIVATE AND SHARED NETWORKS

1990	1995	2000

SUPPLY INFLUENCING FACTORS (NON-POLICY/REGULATORY)

S1 Technological Advancesw

S1.1	Decreasing Network Unit Costs	High-User Owned (Where reflected in CPE) →		
S1.2	Increased Functionality Per Unit Cost			
S1.3	Increased Connectivity/Universality	Low-Carrier Provided (where reflected in carriers services) →		
S1.4	Use of Digital Transmission and Switching			
S1.5	Increased Capacity Per Unit Cost			
S1.6	Terminals With Increased Capabilities/Lower Price	High →		
S1.7	Substantial Reductions in Computing Costs (Processing and Storage)			
S1.8	Evolution of iSDN	0	0-Med(-ve) → depending on price)	

S2 Increasing Sophisticated Public and Private Network Capabilities

S2.1	CCS #7		
S2.2	Software Defined Networks	0	Depends on Price Relative to Public →
S2.3	Value-added/Enhanced Services	High	

S3 Availability of Local Access Alternatives — Low

S4 Free Trade — 0 — Low-Reduced →

FUTURE IMPACT ON USE OF PRIVATE AND SHARED NETWORKS

1990 1995 2000

POLICY/REGULATORY INFLUENCING FACTORS

E1 Liberalized Microwave Licensing

E1.1 Local — Low-User Owned → Low(-ve) Carrier Provided

E1.2 Inter-city — 0 — Low-User Owned → Low(-ve)-Carrier Provided

E2 MTS/WATS Competition

E2.1 Limited — 0 — Low(Depending on MTS/PL Price Relationship) →

E2.2 Open

E3 Local Service Competition

E3.1 Cable Based
E3.2 Radio Based — 0 — Low . Med

E4 Liberalized Sharing and Resale

E4.1 Non-MTS/WATS (P/L) — Low →

E4.2 MTS/WATS — 0 — Low →

E4.3 User Owned Networks — 0 — Low(-ve)Carrier Provided Low-User-owned →

		FUTURE IMPACT ON USE OF PRIVATE AND SHARED NETWORKS		
		1990	1995	2000
E5	Uniform National Telecommunications Policy eg. Terminal Attachment, Interconnection in all Provinces	0	Low →	

Appendix F

Summary of Interviews

	Pricing	Growth in Information Technologies	User Management & Control
Users/ User Organizations	o Price a key factor in using P/L networks o Requirement to move to cost-based pricing o Some large data users consider quality more important than price also seek lowest price o Prices relative to those in U.S. make some users products uncompetitive with those of their U.S. counterparts	o Microcomputer usage is increasing distributed processing capabilities which in turn increase the requirement for telecommunications facilities. One user stated that the high cost of telecommunications is preventing them from automating some sites which require links to the centralized mainframe	o Use P/L to achieve management and control of their own communications facilities o Interviews with users placed user control, price and lack of responsiveness of telcos as key reason for building and managing their own facilities
Telephone Companies	o Must maintain T1/MTS pricing relationship o One telco developing innovative pricing approach to counter P/L growth (pricing package to provide P/L equivalent on PSTN) o Same telco also pricing PSTN long distance services on declining price with volume		o Concerned that telcos may be reduced to transmission function o Users require the flexibility to manage and control their own networks/telcos responding o Responding with virtual networks where users will be able to control the dynamic use of their networks

	Pricing	Growth in Information Technologies	User Management & Control
Manufacturers	o Pricing of T1 so high as to discourage sophisticated networks o If ISDN pricing correct, could greatly stimulate use (business, home) o For voice price is most important/ data quality is paramount o Adopt cost-based pricing	o Moving to greater functionality at the desktop, e.g. fax developing desktop-to-desktop	o Users want to manage networks/available at reasonable cost o One company agreed with U.S. factors as reasons for users wanting to manage their own networks: 1) lack of responsiveness of carriers to user needs 2) technical quality 3) price 4) user control requirements
Regulators/ Policy Makers (Canadian)	o Abandoning T1/MTS rate relationship o P/L rate increases driven by Phase III (Bell, BC Tel) o Communications, on average, not a large cost to business o Service quality as important as price		

	Pricing	Growth in Information Technologies	User Management & Control
Regulators/ Policy Makers (U.S.)	o Pricing a key factor in user's decision to use P/L networks/services o Rate rebalancing stopped some users from migrating to P/L o ISDN may significantly influence pricing		o Increased control/ flexibility important to users
Non-Telco Carriers/ Carrier Organizations	o Significant price differences between Canada and U.S., particularly concerned about higher Canadian T1 rates o MTS being stimulated by lower prices/no resulting economic harm from the lower prices o Rate rebalancing would have no impact on universality (institute lifeline programs) o Price ISDN in relation to costs	o Competition stimulates technological development (under monopoly get sequential replacement of technologies, under competition get parallel development and replacement) o Underlying trend of network is the movement from the batch world to the real time world in data processing	o Users want choice & the ability to build and control their networks o Pay for quality (both high, low) o High level of telecom expertise in user organizations to: 1) control facilities 2) control costs 3) develop telecommunications as a strategic asset

	Economic Situation	Technological Advances	Network Capabilities
Users/ User Organizations		o Some users perceive that telcos not responsive to their needs in providing latest technological advances o No problems with technical aspects of telco networks/ services	o Larger users have a need for ISDN, CCS and SDNs on private networks
Telephone Companies	o Federal tax a distorting factor o In an economic downturn, local rates not LD rates will rise		o Searching for ways to add value to the transmission function (eg. software defined networks) o Applications driving networks/services o Decentralized intelligence o Moving to integrated voice, data and image o ISDN key capability
Manufacturers	o Federal telecommunications tax having negative impact	o Experiencing lower unit costs plus greater functionality	o No need for concern about excess network capacity/growing user requirements o Requirement for band-width on demand o Network diversity/ reliability key issues for many large businesses

	Economic Situation	Technological Advances	Network Capabilities
Regulators/ Policy Makers (Canadian)			o One government receiving but resisting pressure to carry general traffic on P/L network o Same government stimulating informatics/network development
Regulators/ Policy Makers (U.S.)		o Technological advances in in terminals stimulated demand	o Very high quality and security important to some users (often requires P/L)

	Economic Situation	Technological Advances	Network Capabilities
Non-Telco Carriers/ Carrier Organizations	o Installing capacity (eg. fibre) and its subsequent use will have multiplier effects in the economy o MTS/WATS competition could have significant beneficial impacts on the economy	o Advances such as ISDN will only be of significance to users if there are changes in price as well	o Diversity/backup key network features o Concerns about over capacity unfounded (demand will rise to use installed capacity) o Develop competitive ISDNs o Telcos will use CCS, ISDN to provide "large user" services to medium and smaller users (eg. SDNs). This will result in retention and expansion of such users' demand for public network services.

	Local Access	Free Trade	Microwave Licensing
Users/ User Organizations		o Higher Canadian long distance rates cause competitive disadvantage, particularly with larger capacity facilities (eg. T1, T2, T3)	o Private users - liberalized local microwave would have no significant effect on the public telecommunications system - small amount of spectrum - for business only - telcos sell local service at a price below cost - usually applies to custom engineered systems o Very little effect due to high capital costs of providing own microwave facilities
Telephone Companies	o Perceived requirement by one eastern telco for voice and data to every business and home	o Concern for cheaper U.S. equipment being available in Canada	o Fibre lessens the impact of local microwave o Establish microwave policy in context of general telecom policy

	Local Access	Free Trade	Microwave Licensing
Manufacturers		o Competing in global market so pressure on costs re telecom	o Liberalizing local microwave would enable telcos to use local plant more effectively o Few users could justify capital outlay for intercity networks
Regulators/ Policy Makers (Canadian)			
Regulators/ Policy Makers (U.S.)			

	Local Access	Free Trade	Microwave Licensing
Non-Telco Carriers/ Carrier Organizations	o Perceived requirement to solve the allocation from long distance and local services to access o Trend with ISDN to local measured service	o Canadian content regulations negatively impact satellite communications o Dictates that Canada develop a national telecom policy	o Liberalized local microwave licensing could increase satellite usage by facilitating local access o Liberalized local microwave licensing will have very little impact on demand for public services if users do not have interconnection with the PSTN o Use of fibre in local and long distance facilities will limit the requirement for user-owned microwave facilities

	MTS/WATS Competition	Local Service Competition	Sharing and Resale
Users/ User Organizations	o Lack of MTS/WATS competition could lead to more P/L networks o Competition seen as solution to pricing problem		o Federal government could share/resell to provinces o Private users believe sharing and resale of local facilities will increase efficient use of the spectrum and not negatively impact the public telecommunication system
Telephone Companies	o Concerned less with competition from other carriers than competition from users o Telcos require flexibility in pricing with competition	o One telco expects local service competition by the year 2000/ obtaining rights-of-way may be problem	o Sharing results in users reducing control/security
Manufacturers			o Resale of excess capacity seen as important o Current rules depress demand for sharing and resale
Regulators/ Policy Makers (Canadian)			

	MTS/WATS Competition	Local Service Competition	Sharing and Resale
Regulators/ Policy Makers (U.S.)	o Universality not negatively impacted o Stimulated development of regional carriers, networks and services	o No significant impacts from access bypass	o Resale guards against abuses of facilities based competition
Non-Telco Carriers/ Carrier Organizations	o One suggestion to introduce MTS/WATS competition and let the market dictate rates o If MTS/WATS competition not allowed, could result in increased corporate bypass (develop own networks and bypass through U.S.) o MTS/WATS competition would lead to new pricing packages, features and services o If controlled (ie. limited entry), will make the telcos more efficient	o Perceive telcos to be pushing WANs, particularly Centrex based o Local competition would force the telcos to be more innovative (ie. fibre at the local level)	o Current restrictions preventing the sharing and resale market from taking off o Revenue erosion from permitting smaller users to access the benefits of competition through sharing and resale would be small (large users generate most of telcos' revenues) o Open Network Architecture important to resellers/enhanced service suppliers

	National Telecommunications Policy	Other
Users/ User Organizations	o Lack of national policy on interconnection foreclosing competitive supply options	o Telcos not market oriented/not sufficiently responsive to users' needs
Telephone Companies	o Requirement for governments to clearly establish policy	o Image traffic the primary growth area
Manufacturers	o Current interconnection policies limit P/L network choices across country	o Image/video traffic large growth area o Telecom becoming strategic tool to get closer to the customer o Increasing public network demand makes it difficult to substantiate harm from P/L
Regulators/ Policy Makers (Canadian)		o Raised concept: telcos in network business; others in the applications business
Regulators/ Policy Makers (U.S.)		

	National Telecommunications Policy	Other
Non-Telco Carriers/ Carrier Organizations	o Private network growth by non-telco carriers impeded by lack of country-wide interconnection o Lack of a national tele-communications policy restricts telecom competition in Canada	o Satellites offer one-vendor network solution o Users beginning to treat information/ communications as strategic tools o There will be high growth in cellular telephones/personal communications devices which will stimulate demand for local and long distance services